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In the growth of THE ELECTRICAL WORLD in circulation, size and general improvement, the value of its columns for reaching those engaged in electrical pursuits or interested in electrical matters has not failed to be appreciated by advertisers. Readers will find it to their advantage to keep their eyes on the advertising as well as the reading columns. The following are the new advertisements in this issue:

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Vol. VIII. NEW YORK, DEC. 4, 1886. No. 23.

THE paper read by Mr. Townsend Wolcott before the Electrical Section of the American Institute contains much food for thought regarding the action of the iron ring in the Gramme armature. This question, which has been ably treated by M. Breguet, is taken up again by Mr. Wolcott, who attempts to prove the erroneousness of the deductions arrived at by the French scientist.

THE recent rumors of a consolidation between the Western Union and Baltimore & Ohio Telegraph companies seem to have a very slender foundation, considering the good condition in which the latter is shown to be, according to President Garrett's report. The large increase in earnings shown over last year is evidence of the fact that the company has been well able to stand the fierce competition of the older company, and that the low rates prevailing are likely to continue for some time to come.

IT would be interesting to know just what ails Georgia. Not satisfied with producing "electric girls," it now lays claim to a wonderful "electric pit" which is effecting hundreds of cures of rheumatism. "The only theory advanced is that the mud must be charged with electricity." The theory seems to us rather far-fetched. Other and adequate explanations can be found. The average Georgia idea of electricity must be like that of the man who is on record as wanting to buy electric light by the gallon.

THE reaffirmation by the Missouri Court of Appeals, that contracts made by telephone are binding, is one that common sense must approve. No evidence, it appears, was offered in the case considered to show that the instrument was out of order so as to have rendered the conversation unintelligible, and hence the only plea that could have had any significance was not put forward, evidently for good and sufficient reasons. We hope that this will be the last decision required to settle the question of the value of the telephone as a medium for business communication.

THE intelligent efforts made by Mr. W. D. Sargent and his associates in Brooklyn do not enjoy the local appreciation they deserve. Some of the newspaper criticism might lead one to infer that the telephone people had been obstructive rather than helpful to the Brooklyn subway commissioners. The very reverse is the case, as the commissioners would themselves probably be the first to testify, and as might easily be learned from the able and careful paper presented by Mr. Sargent before the telephone convention at St. Louis in September. Mr. Sargent has been found fault with for cautioning the public against the impression that the work can be done in a hurry. Every one conversant with the subject knows that the remark is temperate and timely, and that, let the energy of subway contractors in any large city be what it may, the work must of necessity be one that will occupy years. So far, we have seen no reason for complaint against the New York & New Jersey Company in Brooklyn, but, on the other hand, much cause for praise.

THE announcement made by us some months ago that the system of electrical distribution by secondary generators, and known as the Gaulard and Gibbs, would soon be put in practical operation in this country, is now being substantiated by the actual construction of installations on that plan. Considering the flexibility of the system, not less than the energy of its promoters, there is reason to believe that it will find extensive application. Like all systems, however, it has its particular field of usefulness, and that field is circumscribed by the limits of economy. The governing principle of the system is the conversion of a current of small quantity and high E. M. F. into one of low E. M. F. and greater quantity at the place where it is needed in that form. By thus employing high E. M. F. the size of wire employed can be correspondingly reduced, and in this way it is intended to overcome the heavy expense of laying large conductors, which would otherwise be necessary. It is also intended, obviously, while using currents of high potential for distribution, to keep those currents outside, using the lower and safer currents indoors. This is in itself an admirable feature.

AMERICANS are usually the pioneers in the execution of new ideas, and have earned the reputation of being adepts in the manipulation of "pools" and "syndicates," but it seems that they are still young and innocent enough to learn a point or two from abroad in regard to these matters. The telephone "syndicate" of English origin, described in another column, is decidedly original in many features, and might, perhaps, with profit, be actively taken up by our enterprising tradesmen. The placing of a telephone in private houses, free of charge to the occupants, who are then supposed to give all their orders for domestic necessities to the tradesmen composing the syndicate, will not only act as a stimulus to business in the way desired, but will also greatly increase the receipts of the telephone companies, who would, no doubt, be glad to aid the syndicates in their insidious attack on the pockets of the householder. This plan may, indeed, turn out to be the germ which may grow until we reach the ideal time predicted in the infancy of the telephone, when we shall find a telephone in every house. Might one not look forward even to the time when rival syndicates will not only put in telephones in private houses, but, in lieu of the time-honored "chromo" as a premium on sales, connect the subscriber, free of charge, with the opera, the theatre, or the church, according to the amount of the purchase?

IT seems that the prevalent notions regarding an important law directly applicable to dynamo construction are to be rudely shaken by the results of experiments made by M. Deprez, and detailed in another column. Heretofore special pains have been taken by constructors to reduce as far as possible the space between the core of the armature and the pole-pieces between which the wire is situated in order to bring it under the action of the most intense field. According to M. Deprez, however, excessive refinement in this direction is unnecessary on account of the fact, ascertained by him, that, contrary to the accepted opinion, the magnetic intensity does not vary inversely as the square of the distance, but that the rate of decrease of magnetic strength is far less rapid than the increase in distance; so that the bringing together of armature and pole-piece into too great proximity increases the strength of field very little, while it reduces considerably the space available for active wire. Coming from any one less eminent than M. Deprez, the assertion that the law of inverse squares does not hold good for magnetic force would not be seriously considered; but the high standing and the large amount of original work done by M. Deprez demand recognition here. As M. Deprez presents only a bare outline of the method of experiment pursued by him, it would be difficult to form an opinion regarding the validity of his deductions. They certainly deserve attention, however, and we shall probably hear more of the subject in the future, as the application of these new deductions to the construction of dynamos is of considerable importance.

THE results obtained by M. Deprez in his late Creil experiments have given rise to much discussion, which even now is not ended. The latest chapter to be added to it is that embraced in the experiments made by M. Hippolyte Fontaine, referred to in another column. M. Deprez, it will be remembered, employed a single generating machine, which, with a comparatively slow speed, developed an E. M. F. of over 6,000 volts, with a current of about 10 ampères. The construction of a machine of this nature necessarily required extreme care, especially with respect to the insulation; and M. Deprez imposed an additional task upon himself by working with a slow-speed dynamo, that being considered by him essential for practical, continuous work. M. Fontaine, taking almost precisely the same condition as regards E. M. F., current, external resistance, etc., as those of M. Deprez in the Creil experiments, employs four generators of the ordinary Gramme type, coupled in series to obtain the desired E. M. F., and obtains about the same efficiency as M. Deprez. The idea followed out by M. Fontaine is similar to that put in practice in the construction of large induction coils where special pains are taken to separate as far as possible the windings of the secondary which have the greatest difference of potential. In the same way, by dividing the E. M. F. among four machines, the difference of potential in each one is correspondingly reduced, and the danger of impairing the insulation is avoided. This practice of coupling machines can hardly be called new, being an old device in electric lighting, and it is but justice to M. Deprez to say that, as he claims, the method was embodied in a patent issued to him some time ago.

FOR those contemplating the erection of electric light stations it is of prime importance to know, at least approximately, what the probable amount of current called for will be. It is of interest, therefore, to compare the fluctuations in demand which take place from hour to hour in a large city, as represented on the chart given in another column. The increasing employment of motors on the circuits will probably have a modifying effect on the curve shown, tending to elevate it in the day hours, when the lights are but sparely used. We leave it to our readers of a mathematical turn of mind to calculate the average number of ampères delivered during the twenty-four hours of the day, upon which a definite calculation would be based. The points involved will repay study. It will be noticed that the curve is almost a straight line up to 7:30 A.M., when it suddenly rises, owing to the switching on of the Sprague motors, which are supplied from the station. These are at the present time 24 in number and are being increased. The variation from this time up to 12 o'clock is due principally to the switching on and off of these motors, which are employed in running elevators, both freight and passenger, wood-working machinery, ventilators, sewing machines, printing presses, etc. At 12 o'clock the line falls suddenly, due to the switching off of these motors during dinner hour. Between 1 and 1:30 the curve again rises, and at about 3:30 it takes a sudden jump from 650 ampères to nearly 1,950 ampères. Between 5 and 6 o'clock the lines fall again, due to the large number of stores closing at this hour, as well as to the cutting off of a portion of the light by some of the consumers while absent at supper. At about 7 o'clock, when they have returned from supper, the lights are used again, and a little later their number is further augmented by the lights in the theatre. After 8:30 P. M. the lights fall until midnight, when the lowest level is reached, as a rule, between 200 and 250 ampères. The complete curve shown is for Monday, which, Mr. Hammer states, is generally the heaviest load at present. The other curves have only been carried out during the heaviest hours of lighting, and it will be noticed that their general characteristics are the same as those of Monday. The small curve shown by the fine line is for Sunday, when the load is, of course, the lightest of any day in the week.

The Pre-Determination of the Characteristics of Dynamos.*

BY GISBERT KAPP.

If we know the number of magnetic lines of force which pass through the cross-section of the armature core at the neutral points, the internal electromotive force developed can easily be calculated from the winding and the speed. Adopting, for convenience of calculation, as a unit line that which is equivalent to 6,000 lines in the C. G. S. system of measurement, we have

$$E_a = z_1 N t n 10^{-8},$$

where E is the E. M. F. developed, z_1 the number of unit lines passing through both neutral sections, Nt the number of conductors counted all round the armature, and n the speed in revolutions per minute. This formula applies equally to cylinder, disc and drum armatures, but in the former two types Nt represents the number of complete convolutions on the armature, while in the latter it represents twice that number. The formula also applies equally to bipolar and multipolar machines, the only difference being that in the latter cases the neutral sections to be considered are not diametrically opposite.

The question to find the E. M. F. of a given armature, therefore, resolves itself into the determination of z_1, the number of lines passing through the armature core; and in the following I would submit a suggestion for the solution of this problem, if the constructive details of the machine, the exciting power, and the quality of iron are known. Stated in other words, the problem is to construct the characteristic curve of a dynamo from its drawing without having recourse to experiment.

Since the usual characteristic representing the relation between exciting current and electromotive force depends on the speed, it is more convenient to use the characteristics of magnetization, where abscissæ represent exciting power and ordinates the number of useful lines. As far as I am aware, the only attempt to represent the relation between these quantities mathematically is the ingenious and very simple formula by Fröhlich, which has been further developed by Prof. Silvanus Thompson. According to the original notation of Fröhlich the effective magnetism (M) is represented by

$$M = \frac{i}{a + b\,i}$$

where i is the current of a series-wound dynamo (therefore proportional to the exciting power), and a and b are constants to be determined experimentally for each machine. For an infinite current the magnets become saturated, and the effective magnetism equals $\frac{1}{b}$. If now absolute saturation be considered as unity, and actual magnetization be expressed in reference to it, the formula is further simplified to

$$M = \frac{i}{a + i}.$$

In this case the constants to be determined experimentally are a and the E. M. F. corresponding to saturation. In Prof. Thompson's well-known modification of this formula, $H = \frac{G \varkappa S i}{1 + \sigma S i}$, there are also two constants which require experimental determination—G, the geometrical constant depending on the configuration of the machine, and the saturation coefficient σ "which is the reciprocal of that number of ampère turns that will bring the magnet up to such a degree of saturation that its susceptibility is halved."

Now this necessity of making at least two experiments in order to determine the value of the constants in each particular machine limits the use of either formula to such cases where the new machine differs from that experimented upon in the winding only, but not in size or type. There is another drawback. Fröhlich himself says that his formula only gives correct results if used between limits for which his "curve of current" can be considered as a straight line, and, generally speaking, it will therefore not be possible to construct the whole of the characteristic of magnetization, even if we have made the necessary experiments for the determination of the constants.

It was with a view to do away with preliminary experiments of the nature alluded to that about two years ago I began to make use of a formula by which the strength of field could be determined from the electrical, magnetic and mechanical data for each design of dynamo. This formula is based on the conception of magnetic resistance—a quantity proportional to the ratio of length divided by area, and in so far analogous to electrical resistance, but differing from the latter in this respect, that the coefficient with which the ratio of length to area must be multiplied (the specific resistance) is not a constant, but varies with the density of lines flowing through the iron, and reaches infinity at absolute saturation. As regards air or non-magnetic metals this coefficient is, however, assumed to be a constant. The formula, as published by me in a paper read last year before the Institution of Civil Engineers, is

$$z_1 = \frac{P}{R_\alpha + Ra + R_f},$$

where P is the exciting power in ampère turns applied to the horseshoe magnet which produces the lines z_1, and R_α, Ra, R_f, are the magnetic resistances of the air space, armature and field-magnet respectively. The resistance of air space is found by multiplying twice the interpolar distance given in inches (twice because the lines must leap into *and* out of the armature) with the constant 1440, and dividing the product by the polar area. In this case the numeric 1440 is the specific magnet resistance of air in the arbitrary system of measurement we have adopted. The other two resistances are for very low degrees of magnetization, found in like manner by determining from the drawing of the dynamo the average distances through which the lines flow in armature and magnet, and dividing by the respective areas; the ratio in each case being multiplied by the numeric 2, which represents the initial specific magnetic resistance of annealed wrought iron. The above empirical formula is only correct for low degrees of magnetization, and consequently for comparatively weak exciting powers. Assume we have made the calculation and determined the ratio (represented by a straight line) between E_a and P for a given speed. If we now work the dynamo under these conditions, we find that the actual E. M F. observed is either equal to, or

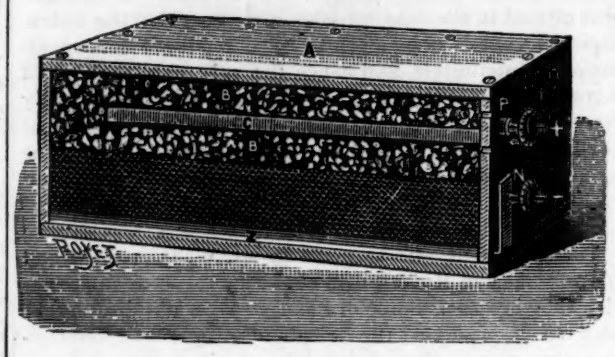


FIG. 1.—THE "COFFERDAM" CELL—SECTION.

slightly higher than, the calculated E. M. F., but seldom lower. In other words, the actual initial value of the magnetic resistance is either equal to, or slightly less than, the calculated value. This is probably due to the neglecting of the influence of edges of pole-pieces, and to errors in estimating the lengths and areas of the flow of lines. Nature finds the easiest way for this flow, and since it is obviously impossible for us in our calculation to hit on a still more easy way, we are likely to obtain (when working with the greatest possible care) a slightly higher resistance. The error is, however, generally very small, and is of no influence on that part of the curve which is of practical importance.

(TO BE CONTINUED.)

* Read before the Society of Telegraph Engineers and Electricians.

"Cofferdam" for Voltaic Batteries.

The name of "cofferdam" has been given, according to *l'Electricien*, to a curious substance, a preparation of cellulose, which has recently been obtained by a young French chemist, M. P. Germain. Its uses in connection with electricity have been investigated by M. André Rey-

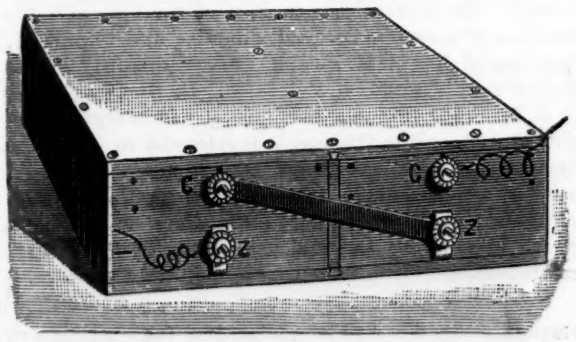


FIG. 2.

nier, the electrician to the Société Générale des Téléphones. From a report which has been written by M. Reynier, we gather that "cofferdam," or "sporique," as its finer variety is termed, is prepared from the husks of the cocoa-nut; it has the color and aspect of cacao powder. The extraordinary properties of this substance arise from its extreme lightness, its specific gravity being represented by the abnormally low figure of 0.08. Under the simple pressure of the hand its volume can easily be reduced to one-third, and even then its density is only about one-fourth that of good sponge. Its absorbing power surpasses that of all other known materials. A given volume of cofferdam can easily be made to take up a volume of liquid equal to itself, without any perceptible increase in the total volume; or, in other words, the volume occupied by the cofferdam in the combination is *negligible*. A good sponge will absorb seven times its own weight of water, cofferdam absorbs 12.5 times its weight of water. The substance has hitherto been found to be insoluble both in acids and in alkalis and in solutions of salts. It is therefore evident that it will thus readily lend itself for use in primary or secondary batteries. M. Reynier states that the resistance of the battery is not perceptibly increased by its presence, and it is suggested that by saturating two separate slabs of the substance it may be employed in two-fluid batteries, thus doing away with the porous cell. Not only are the liquids thus kept separated and preserved from accidental spilling, but it is also found that the loss from evaporation proceeds much more slowly.

Our illustration, Fig. 1, is a section of a cell showing the disposition adopted for employing the "coffer dam" in connection with the Leclanché cell. Fig. 2 shows the cell complete.

Within a box A, which is made water-tight by paraffining, there is first inserted a layer B, composed of a mixture of peroxide of manganese and granulated carbon; then a sheet of agglomerated carbon C, of high conductivity; then a second layer B' similar to B. The rest of the box is filled up with a layer D of the normal coffer-dam paste, holding in suspension a hot saturated solution of sal-ammoniac. This paste is lightly pressed and then leveled. Finally, a plate, or better still, a series of plates, of zinc, well amalgamated, covers the coffer-dam and protects it from the action of the air. The back of the zincs is protected from corrosion by a layer of varnish.

We have described the contents of the box in the order in which they are inserted. Once finished, however, the box is maintained in the position shown in the engravings. The object of this is to permit the weight of the superincumbent mass to cause a good electrical contact between the solution and the soluble electrode, the zinc, and on the other hand to permit the ready escape of the gas through the porous material above.

The cell above described can be subjected to very rough treatment without deterioration. It is also claimed that for equal electro-chemical capacity, this form of cell occupies considerably less space than the liquid form.

The Julien Electric Car.

A writer in the Philadelphia *Daily News* gives an interesting account of the manner in which the Julien electric tramcar was brought to this country, and of those interested in its exploiting here:

"In December, 1885, William Bracken, a bright young New York lawyer, went to Europe on a business trip connected with a highly valuable wire twist shoe patent. In Brussels, in May, 1886, he saw the Julien traction system in practical operation, and was amazed at its efficiency. He quickly made the acquaintance of the inventor, and no grass grew under his feet while he was completing the arrangements for an American company. The foreigners had little conception of the immensity of the street-car service in this country. Mr. Julien appeared rather doubtful of the statement that the cities of New York and Brooklyn combined used more street cars than the entire kingdom of Belgium, and the assertion that in the city of Philadelphia alone there were three hundred and forty-three miles of railway track was secretly accepted as a specimen of American exaggeration. But the necessary papers were signed, and Mr. Bracken, after having arranged for the prompt building of a car for experimental tests in New York, returned home to get his company in shape.

"Mr. Bracken is known to many of you. He read law with Henry M Hoyt in Wilkes-Barre and completed his studies with George Northrop in this city. In 1883 he moved to New York, and has since been practicing at its bar with success. He is industrious, energetic, and, above all, practical. He organized a company with himself as president; Richard Arnold, of the New York Produce Exchange, as vice-president; Stephen D. Hatch, the architect of the Murray Hill Hotel, the Gilsey House and Boreel Building, Broadway, as treasurer; Pedro G. Salom, the consulting and analytical chemist of this city, as secretary, and a board of trustees, including Henry G. Morris, of this city, formerly of Morris & Tasker, and a mechanical engineer of high standing. The experimental car was to have been ready last June, but the lack of knowledge among foreigners concerning the peculiarities of our street railway methods interfered in an unexpected way. The vehicle to which the motor was attached was one of our ordinary tram-cars built by Stephenson in this country. This was selected rather than one specially constructed for the purpose, in order to show that no change in rolling stock would be made necessary by the introduction of the new system. Mr. Julien accordingly supplied it with batteries capable of producing power sufficient to carry thirty persons. Mr. Bracken sent him a frantic cablegram, stating that the motor would have to be sufficiently powerful to move seventy passengers. Mr. Julien was serene in his belief that it would have to do nothing of the sort, for the very simple and apparently very conclusive reason that the car could only seat thirty persons. In Belgium and France you must understand that when every seat in a street vehicle is taken a placard bearing the simple announcement, "Complet," is displayed, and while it hangs forth no one attempts to enter the car. It took some time to explain to Mr. Julien that in America railway officials crowd even as many as one hundred persons into a single street car, and if they didn't do it they would be roundly abused by the average man, to whom the idea of staying his frantic rush through life by obliging him to "wait for the next car" would be maddening. So Mr. Julien had to supply the car with new batteries, and it arrived in New York several weeks ago in readiness to carry seventy passengers." Those passengers have now been carried.

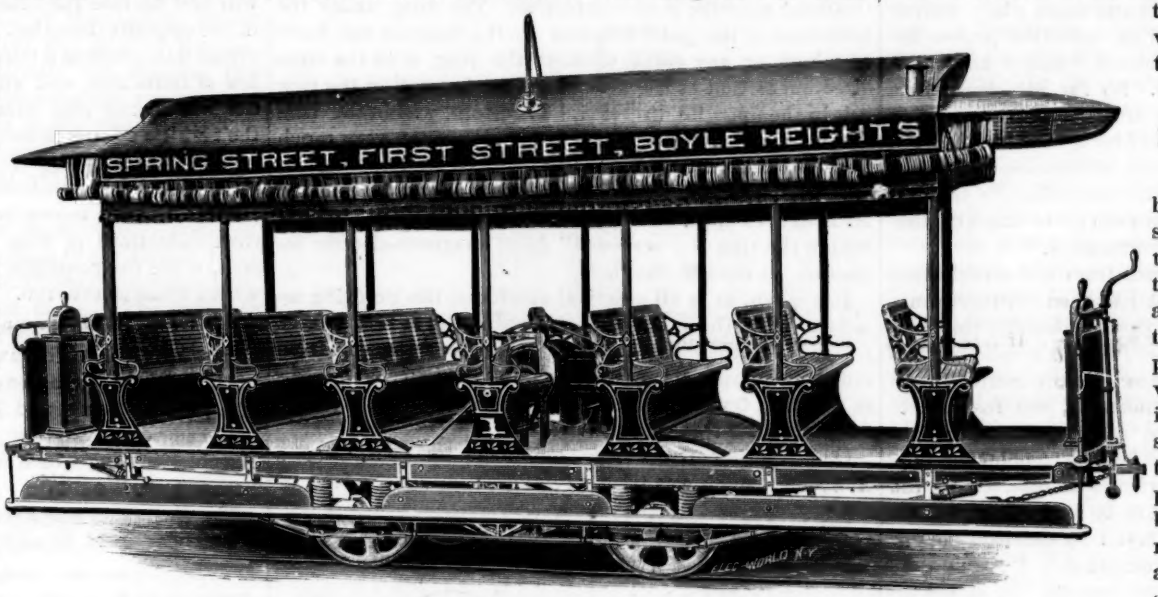
The Los Angeles Electric Railway.

We have already made mention of the fact that construction had been begun on the electric railway for Los Angeles, Cal., where the Daft Electric Light Company are now equipping two roads, one being 3½ miles and the other about 2½ miles in length. Our illustration represents one of the cars forming part of the equipment of the First Street Railway, which, together with an independent motor, is now on its way thither, and will soon be followed by others for the Pico Street Railway.

The car, as shown, is a seven-seated summer vehicle, having the motor placed in the centre in such a manner as to occupy the space of only two passengers, leaving both platforms clear, and it is so connected that all the driving wheels are equally actuated, for the purpose of insuring the highest tractive capacity. The car is supplied with two switches placed on the platforms, from either of which it can be operated, thus enabling the driver to always occupy the front platform when operating. The switch not in use is locked by a convenient device, so as to prevent tampering. Cars of this type have been thoroughly tested up to a speed of ten miles per hour, and are found to work very promptly, and with so little noise that no inconvenience is experienced in occupying the seats close to the motor.

In illustration of the complete mechanical balance of the connections between the motor and the driving wheels, test runs have been made with thirty men placed on one end of the car, so as to completely close up the springs on that end. The result was entirely satisfactory, the car running as smoothly and easily as when "on an even keel."

These cars will be connected to two overhead wires by means of a flexible "traveler" of peculiar construction, which can be operated on turnouts with perfect ease. An interesting feature of these motors is the extreme simplicity of the governing devices and the brush attachment by means of which the whole government of the car is effected from one small lever. By the same means the motor may be reversed at full speed without the slightest injury to the apparatus, bringing the car to a stand in a very short distance.



CAR ON DAFT ELECTRIC STREET RAILWAY, LOS ANGELES, CAL.

A Novel Telephone Syndicate.

"I have been asked to join a telephone syndicate, and I want to know what it is." Thus inquired a friend of mine the other day. Now, I do not know much about syndicates generally, except that some men who suddenly rise from mediocrity to opulence tell me they have joined a syndicate and made a nice pile out of it. But a "telephonic syndicate" I do know a little about, and as my friend is very likely to be only one of many who thirst for knowledge, I will try to explain the sort of thing he has been asked to join. "Shopping" is one of the wearisome institutions of civilization. I often want some article or other, and yet for weeks leave the shop unvisited simply because to a busy man, like myself, time is so valuable. So much for me. But my wife? Butcher, baker, poulterer, greengrocer, fishmonger, dairyman, and I know not how many more, call for orders every day, and all the morning is spent in answering the maid, who comes to say, "Please, 'm, the butcher," or "Please, 'm, the greengrocer." If my wife can order by telephone, the tradesman is relieved of the expense of sending for orders, and hers and the maid's time is saved. What a blessing it would be! Good. But a telephone costs £20 a year. Here comes the agent of "a syndicate," or association of the sharp tradesmen in my neighborhood, and says that a telephone will be fitted up if I will give—what? my permission! These traders find it so much to their advantage to have orders by telephone and save time, that they have united to furnish a hundred houses in the district with the time-saving instrument gratis. I have my coal from Tompkins, who has no telephone, but here is a coal merchant in the "syndicate," and I have only to look at a little hole, ring a bell and say, "Four tons of Wallsend," and round comes the load, while the rain pelts down and the mud splashes. My boots are not soiled, my clothes are dry, and Tompkins wonders why I haven't been round lately to order my coals. Why? Because I have called up 534 and ordered the coal by telephone. On the telephone hangs a card, and on the card are printed about 20 tradesmen's names, who form the syndicate. Finn the fishmonger, Jones the baker, and all the other leading men, the sharp, shrewd fellows who know the innate laziness of the Briton's constitution, and, by saving me trouble, gain trade for themselves—here they are, set down in order, and, without stirring from the house, we can command an army of ready caterers. In cases of interesting domestic emergency, or of accident, there are the doctor and the chemist on the list. Nor is this all. I have a cold, perhaps, and cannot go to town. Here is the rub. This telephone is on a small "primary exchange," and how can I call to 7,654, for instance, on another exchange? The local syndicate give me their instrument, but it is obvious that for me to call some one not connected with the syndicate entails expense. Very well. All that is arranged. I call my local exchange; they switch me on to the trunk line, and so to 7,654, my town office, and debit me with threepence for the message—not of twenty words, but of whatever length may suffice for the business in hand. Further, my wife wants to ask Mrs. Mortimer to come in to-morrow for a social afternoon. Mrs. Mortimer is on our "syndicate," my wife calls the exchange; the exchange calls Mrs. Mortimer and the thing is done. The syndicate pays well. What the traders pay is not, be it well observed, an actual outlay, but really only a commission on orders received by telephone. In my friends' neighborhood several firms have expressed their willingness to pay 5 per cent. on such orders. Telephone enterprise is old enough to be secure from idle opposition and the effects of panic, and yet quite young enough to show fine promise of a grand future. So, my advice to my friend was, "join the syndicate." It is beyond all question a capital idea, and its successful adoption in many parts is encouragement to the sharp tradesmen in all localities to follow the lead, to oblige their customers and to fill their own pockets.—*English Western Morning News.*

Sound Telegraphs.

The system of sound telegraphy used by the people living on the border of the Gulf of Guinea, West Africa, is of interest as a primitive solution of the problem of communication through short distances. The instrument is made as follows: Take a log of hard wood about 2 feet long and about 1 foot in diameter. Plane off one side longitudinally to a surface 4 or 5 inches wide. In the centre of this surface mark off an elongated and somewhat distorted Greek cross. The longer arms are placed longitudinally and occupy about one-third of the plane surface. The transverse arms are three times as broad and extend entirely across this surface. The natives dig out the wood within the outline of the cross, and from there gradually hollow out the whole log. The sides, beginning at the centre, are trimmed off laterally toward the ends, which are rounded off. The instrument is now ready. It will be perceived that by the methods above described we have a hollow drum with four tongues in the centre, each of a different thickness, so as to produce a different sound when struck. Two pieces of bamboo the size of a man's wrist and about two feet long, are selected and stripped of the hard outside, which leaves the soft, pithy portion for use. This bamboo is of a peculiar kind, free from knots and solid throughout. With these sticks used in a proper manner on the four tongues of the drum, a combination of sounds is produced which, in connection with time as used in music, forms a perfect telegraphic language, readily understood by the initiated, the air being the transmitter. With this simple instrument the natives of the Gulf of Guinea readily communicate with each other for a distance of one mile at least on land, and a much longer distance by water. Messages can be sent long distances in a short time by parties at different points passing them along from one to the other. It is said that canoes have been seen coming down a river from the bush markets, signaling people in the town and giving and receiving general news at a distance of fully three miles.

Rochester's Telephone Fight.

A dispatch from Rochester says that a meeting was held at the Whitcomb House on the 24th ult., to take preliminary steps toward the formation of a new telephone company. The proposed invention, which will be pushed, is the make-and-break telephone of Messrs. Dann and Lapp, of Honeoye Falls. This is alleged to work upon an opposite principle from that of the Bell telephone, making and breaking the circuit instead of having an undulatory current. The company which it is proposed to form will not be merely for local service, but will be a parent company, the same as the Bell Company of Boston. It will go into the field with the view of fighting the Bell Company, and will have ample capital to carry on the contest.

After a telephone exchange is put into operation for Rochester, exchanges will be formed in various cities in the same way that the Bell Company interwove local companies all over the country. Rochester was the home of telegraphy, and Rochester capitalists first gave life to the Western Union. It is proposed that Rochester shall give to the country a rival telephone company, and make competition where there is now monopoly. A number of local capitalists have manifested their readiness to invest in the enterprise, and there is every indication that it will be pushed to at least a direct issue with the Bell Company.

A hot fight is anticipated with the Bell people. They will undoubtedly carry the matter into the courts as soon as the first telephone is put up, but Dann and Lapp are confident of success.

There has been practically no telephone service whatever in Rochester since the fight began. Most of the merchants have their telephones disconnected and placarded with such mottoes as "Death to Monopoly," "Closed for Repairs," and "Curfew Shall not Ring To-night." The District Telegraph Company has had to double its force of messenger boys, and immediate postal delivery business has increased 50 per cent. All instruments in public offices are closed. Manager Mallett is coolly awaiting the outcome of the fight. It is probable that the telephone girls will shortly be laid off until the trouble is settled. The General Manager of the company, Mr. E. J. Hall, when asked as to the probable outcome, said: "I am not disposed to speak on that point. They have instituted a boycott, and I presume when they get tired of the inconveniences, they will be glad enough to resume their telephone service."

Electric Lighting in Boston.

When the electric light first began to be introduced in the streets, stores and offices of Boston, says the local *Advertiser*, all the profits of the invention were absorbed by the companies controlling the patent, while the corporations engaged in the actual work of constructing and operating the electric lighting plants seemed to have entered upon a thankless and profitless enterprise, whose inevitable end was bankruptcy. But under good management these conditions are now changing, the operating companies are approaching a sound business basis, and the parent companies are forced to be content with a much smaller share of the profits.

The number of companies engaged in the business of furnishing electric lighting plants in Boston, or of maintaining and operating them, is so large at the present time that competition is putting the lights within the reach of the public at very moderate prices. The difference between the electric lighting service and the telephone service in the matter of competition is very marked. Of the various local electric lighting companies, five different corporations compete for the business of furnishing arc lights for stores and streets. About 480 electric street lights are in use in Boston, the greatest number being furnished by the Brush Electric Lighting Company, of which Mayor O'Brien is treasurer.

The city advertised for bids some time since for furnishing electric street lights, and received offers from the Brush, the New England Weston, the Citizens', the Merchants', and the Charlestown Gas Company. The Charlestown Gas Company has lately put in a small electric lighting plant, and is furnishing electric lights in the Charlestown district. Nearly all of the bids were at the same figure, 65 cents per light per night, and it was possibly for this reason that no awards were made, the lighting being done by the same companies as heretofore, without any new contracts.

The City Auditor's report shows that the sum of $101,978.65 was paid by the city for electric street lighting last year. Of this amount the Merchants' Company received $5,946.38, the Citizens' $6,729.66, the New England Weston $34,732.74, and the Brush (Mayor O'Brien's company) $54,569.87. Not more than a third of the business of the Brush Electric Lighting Company, however, consists of street lighting. It probably furnishes twice as many lights for stores as it does for the streets.

Cleveland Wires.—The subject of underground wires continues to be agitated in Cleveland. The city Board of Improvements had a hearing on Nov. 26, when the Dorsett system was brought to notice and discussed.

On the Theory of Magneto-Electric Induction as Applied to the Gramme Ring.

The growing interest which is manifested in the proceedings of the Electrical Section of the American Institute is shown by the constantly increasing number of those present at the meetings. At the last meeting, held on November 24th, Mr. Townsend Wolcott read an interesting paper, which was accompanied by experimental demonstrations in which the President, Dr. P. H. Vander Weyde, assisted, Mr. J. M. Pendleton presiding temporarily. Mr. Wolcott's paper, entitled as above, is given below:

In this paper I do not propose a new theory of induction, nor even a modification of the present theory; but, on the contrary, I desire to point out some erroneous deductions from, or misapplications of, that theory, which have crept into electrical literature, without (so far as I am aware) any opposition.

Maxwell being the highest authority on the subject, we will refer to him. In Art. 531 of his work we read: "The whole of these phenomena may be summed up in one law. When the number of lines of magnetic induction which pass through the secondary circuit in the positive direction is altered, an electromotive force acts round the circuit, which is measured by the rate of decrease of the magnetic induction through the circuit."

This law is a generalization from the phenomena noticed in the preceding article, which includes all possible cases of induction, viz.: "1. Induction by variation of primary current. 2. Induction by motion of the primary circuit. 3. Induction by motion of the secondary circuit. 4. Induction by the relative motion of a magnet, and the secondary circuit," in which a magnet is substituted for the primary circuit. It will be noticed that the criterion of induction, viz., that which is necessary and sufficient, is a relative motion of conductor and field of magnetic force. This is the central idea of this paper.

In a circuit carrying a fluctuating current, or in a circuit in which a relative motion of its parts takes place during the passage of a current, there is an inductive action between these parts, the total amount of which is known as the self-induction of the circuit. So far, all electricians are agreed; yet when the theory of dynamos is considered, these principles are quietly ignored by at least one eminent electrician. In Dredge's "Electric Illumination," in connection with "The Theory of Dynamo-Electric Generators," Professor Silvanus P. Thompson gives his explanation of the "dissymmetry of commutation."

He proceeds on a theory deduced from the experiments of M. Breguet, to elucidate what has been "hitherto supposed to be irreconcilable with theory, namely, the practice of electrical engineers in setting the brushes or collectors of the current in dynamo-electric machines in an oblique position against the commutator, and unsymmetrically with respect to the field magnets of the instrument." He adds: "We shall also be able to point out how this angular position of the brushes is affected by the question whether the machine is to be used as a generator or as a motor. The real part played by the iron core or the rotating armature is also elucidated." "Around the conductors which carry the electric current" (*i. e.*, the armature), says our author, "there is also a 'field' of magnetic force. The presence of the current then changes the total directions of the forces at work in the field, and throws the lines of force into new places."

Now, although the total or resultant field is thus modified, the component of the field due to the current in the armature revolves with the armature, that is to say, has no motion relative to the armature, and, therefore, can have no inductive action upon it. The explanation of the case of a motor where the "lead" is negative, is, of course, equally invalid. Furthermore, he speaks of the "presence of the current" in the armature as being the modifying cause. There is nothing said about the velocity of rotation; in fact, this theory does not take it into account at all, as the rotation of the armature cannot modify the field of force, and yet he says himself that the displacement increases with the velocity.

The lead in a generator is, in my opinion, due to several causes. Let Fig. 1 represent three coils moving in a magnetic field in the direction of the arrow. The middle coil is on the median line, or so-called theoretical commutating point. At any previous moment it has had the total current of the machine circulating through it in the same direction as in the left-hand coil; at any future moment it will have this current circulating through it in the opposite direction, or the same as in the right-hand coil. If these coils are placed closely side by side, as in the Gramme machine, the effect of this reversal in the middle coil is to assist the current in the left-hand coil, and to hinder that in the right-hand coil, and thus advance the reversing point in the direction of rotation. By giving the brushes a lead in the same direction we introduce an electromotive force (that primarily due the rotation of the armature in that part which lies between the new and the original position of the brushes) in the opposite direction, which tends to hasten the reversal. As the velocity of rotation increases, the time of the passage of a coil from the median line to the line through the brush is lessened, and it becomes necessary to introduce electromotive force; that is, to give the brushes more lead. If the form and relative position of the coils be changed, their coefficient of mutual induction will be changed, and with it, according to this theory, the lead also. I think that my experience justifies me in saying that such is the case.

In many dynamos the point of maximum efficiency, which is in one sense the commutating point, does not by any means coincide with the point of least sparking, at which point the brushes are always set in practice, and, so far as I know, these points never exactly coincide. In the old intermittent current dynamos, and to a less extent in continuous current machines in which the continuous action is imperfect, the potential of the field magnets rises and falls with each electric impulse of the armature. The effect of this is, at the beginning of each impulse, to resist the impulse (Faraday's extra current of closing the circuit), and at the end of each impulse to assist the impulse (Faraday's extra current of breaking the circuit). Both are retarding effects and cause a lead in commutation. The point of minimum sparking is that at which these extra currents, together with the mutual induction currents above mentioned, are neutralized; while the point of maximum efficiency is in general nearer the median line, as in neutralizing these currents part of the electromotive force of rotation is also neutralized. In a motor the electromotive force of rotation is in the opposite direction to the current, and by a train of reasoning similar to that

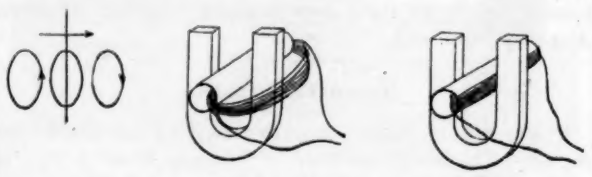


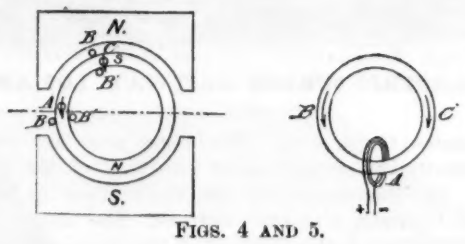
Fig. 1, 2 and 3.—Experiments in Induction.

applied to generators, we show that the commutating point has a negative lead.

M. Breguet's theory of the action of the iron ring in the Gramme machine is also defective. The ring under the induction of the poles becomes itself a magnet, the force of which, at any point without the ring, is in the same direction as that of the field magnets; but within the ring it is in the opposite direction. Therefore, within the ring the resultant force is zero, or, at all events, very much less than without. Now, providing the ring remains stationary while the wire of the armature revolves, as in M. Breguet's experiment, we may consider that the wire within the ring is "screened" from magneto-electric induction, as does M. Breguet.

But when, as in all practical machines, the iron ring revolves with the coils of the armature, it is not correct to assume that the internal wire is screened from induction simply because the resultant force is zero within the ring, for in the following experiments there is induction under this very condition.

One experiment was suggested to me by Prof. Charles A. Seeley, which was tried as follows: A short piece of



Figs. 4 and 5.

gas-pipe was taken, and an insulated wire passed through the bore, brought back on the outside, and passed through the bore again, until a considerable coil was made. The coil was placed, as in Fig. 2, with the gas-pipe between the poles of a magnet, and the wires connected with a galvanometer. The coil was now suddenly withdrawn from the magnet, and the deflection of the galvanameter noted.

Next, the coil was so placed that the free wire was between the poles, and the gas-pipe outside, and again suddenly withdrawn. Now, if there were any screening of the internal wire, the current in the second case would be greater than in the first, as nearly all the magnetic field is between the poles. But, as I had predicted, the current was sensibly the same in both cases. As the first swing of the needle was nearly a complete revolution, the galvanometer was sufficiently delicate to be decisive in the next experiment, which is susceptible of much more accuracy, and which was tried as follows: The external wire was pressed close to the gas-pipe, and the whole placed between the poles of the magnet as shown in Fig. 3. Were the gas-pipe not there, a vertical motion of the coil (by Ampère's first experiment), could not produce a current, but if the gas-pipe had a screening action, even if only partial, there would be a current. As no deflection of the galvanometer could be obtained, I concluded that, in this case, there was no screening, or that the induction, where the resultant force was zero, was as great as elsewhere, as the component of the field due the gas-pipe moves with the wire. Had the gas-pipe been fixed to the magnet, there would have been a current as far as the bore would allow the coil to move.

What, then, is the action of the Gramme ring when it revolves with the coils? I explain it as follows: A molecule situated at *A*, Fig. 4, will have its magnetic axis vertical, with north pole down, as indicated by the arrow. When, by the rotation of the armature, the molecule has reached the point *C*, its magnetic axis is parallel to its first position. At intermediate positions, the direction of the axis may have varied more or less from parallelism, but the total or integral rotation is zero with respect to the field magnets, or a quarter rotation with respect to the wires *B*, *B'*. The induction on *B* is in the same direction as that of the field magnets, and on *B'* in the opposite direction. All the other molecules of the ring act in the same manner, so that the induction on *B* is the sum of the induction of the field magnet and that of the ring, or the same in amount as though the ring were stationary; while on *B'* it is the difference of these inductions, and in this case, also, the same as though the ring were stationary. If the resultant force within the ring be zero, then the induction will be zero.

We have then an action which may, in a certain sense, be called "screening," though not in the sense in which M. Breguet uses the word.

In this last case, of a ring revolving under the influence of a magnet, the molecules (or, if we prefer, the elements of volume), must be considered separately, as, according to my theory, everything producing a magnetic field and having an independent motion must be treated independently.

If a perfectly true and homogeneous iron ring be magnetized by a current in a wire which is wound with perfect symmetry over the whole ring, the resultant force at every point without the iron (both within and without the ring) will be zero, however intense the magnetization. Let such a ring be linked with an ordinary coil of wire as at *A*, Fig. 5, and suppose the ring magnetized in the direction indicated by the arrow *B*. It is evident that the coil *A* incloses the total magnetic induction of the ring in one direction.

Now, if the current be reversed, the polarity of the ring will be reversed, as indicated by the arrow *C*; the coil will now inclose the total magnetic induction of the ring in the opposite direction. If any one doubts that this reversal will produce a current in the coil, let him study the law of induction, and also try the experiment; and yet, the whole coil and every point of it is situated where the resultant force is zero, that is, in precisely the same condition as M. Breguet's screened wire.

Here again the molecules must be treated separately, as the field of each moves independently, and the sum of all their inductions is what it should be to produce the current, while the resultant of all their force is zero everywhere without the iron.

In the discussion which followed the reading of the paper, Mr. C. O. Mailloux stated that he was the first one in this country, he believed, to utilize the fixed spectrum of a magnetic ring, and he referred to papers which he had read before the New York Electrical Society during March, 1883, and which were published at the time in The Electrical World.

The discussion was also participated in by Dr. Vander Weyde, Mr. J. M. Pendleton and others.

Contracts by Telephone Legal.

The Missouri Court of Appeals has rendered a decision holding that contracts made over a telephone wire are binding. The suit was brought by the Globe Printing Company against Stahl & Co. on a bill for advertising. The defendants pleaded that the contract was not binding because it was made over a telephone wire. Judgment was rendered against the defendants in the Circuit Court, and an appeal was taken. The Court of Appeals affirms the judgment of the lower Court in an opinion by Judge Thompson, who says, in part: "The telephone, although of very recent invention, has come into such common use that we think the courts may properly take judicial notice of the general manner and extent to which it is made use of by the business community. No doubt very many important business communications and transactions are made every day by telephonic communication of precisely the same character as that of which the witness was allowed to testify in this case. A person is called up by one desiring to communicate with him by means of a connection of their respective wires through what is known as the central office, and a conversation ensues. It may relate to most important matters of business. The use of this instrument facilitates business to such an extent that it would be very prejudicial to the interests of the community if the courts were to hold that business men are not entitled to act upon the faith of being able to give in evidence to juries replies which they receive to communications made by them to persons at their usual placesof business in this way."

Electric Light for Microscopic Projections.—Prof. Stricker, in lecturing at Berlin before the Society of Natural History and of Medicine, has employed with much success an arc lamp of 4,000 candle-power for the projection of microscopic sections upon a screen, employing a magnifying power of six to eight thousand diameters. Of course, the success of an experiment of this character depends almost entirely upon the optical qualities of the apparatus, but in this instance it is stated that the definition obtained was so satisfactory that "important results in the progress of the study of anatomy" are anticipated from the further use of the electric light in this connection.

The Fluctuation in the Demand for Current from Central Stations.

It is well known that the demand for the electric current in central stations supplying incandescent lamps varies considerably from hour to hour and to some extent from day to day. With the advent of the electric motor connected to such circuits, however, the rate of fluctuation is apt to be changed materially, for whereas the lighting current is usually a maximum in the evening, that required for power is a maximum in the morning. It is interesting, therefore, to examine a chart giving the amount of current drawn from a station at every hour in the day, for every day in the week.

The one represented in the illustration has been prepared by Mr. Wm. J. Hammer, the manager of the Edison Electric Illuminating Company of Boston, and represents the work done by the Edison station there. The verticals represent the hours of the day and the horizontals the strength of current in ampères. The diagram is so clear that further explanation seems unnecessary.

The Gaulard and Gibbs System of Electric Distribution.

Considerable curiosity has been aroused by the announcement in the daily press that a system of electric distribution had been invented and patented, the employment of which would effect a large saving in the cost of conductors. In the notice of the issuance of the patent which appeared in our "Illustrated Patent Record" we made mention of the fact that the system was that of Messrs. Gaulard and Gibbs, which had already been described in our columns; but the announcement that the same has been adopted by the Westinghouse Electric Company, of Pittsburgh, who propose to put it in active operation in this country, may make it of interest to recall the details of the system as disclosed in the patent just issued.

The system is that known as the distribution by means of "secondary generators." The general principle of the secondary generator is analogous to that of the well-known inductorium or induction-coil, with this exception, that while the induction-coil has heretofore usually been employed to transfer electric energy from currents of low potential and great quantity into currents of high potential and small quantity, the function of the secondary generator or converter as applied to this system is precisely the reverse of this—namely, to transfer electric energy from currents of high potential to currents of low potential and increased quantity. Hence, as shown in Fig. 1, one form of converter consists of an induction-coil in which the primary is of fine wire of many turns, and the secondary of few turns of heavy wire.

The general arrangement of the system is shown diagrammatically in Fig. 2. Here C and C' are the converters, and the primary current traverses the circuits 3, 4, 5, 6, 7, 8, 9, passing through the primary wires of both converters, and the separate groups of lamp L L' are brought to incandescence by the secondary, induced current. Each convolution of the secondary conductor is interposed between two adjacent convolutions of the primary conductor, so that the number of convolutions, as well as their mean distance from the axis of the core, is the same. Experience indicates that the more nearly the last-mentioned relation is preserved the higher will be the efficiency of the apparatus. The relative disposition of the primary and secondary helices may, however, be varied considerably.

It is evident that a continuous primary current of uniform strength would have no effect on the secondary generators, and hence an alternate current machine D is employed, which sends alternating positive and negative currents into the line and through the primaries of the converters, with corresponding effect on the secondaries. As the field of the dynamo is required to be maintained constant in polarity, a separate exciter E is employed in connection with the dynamo. The strength of the alternating current can thus be varied by changing the field, which is effected by a rheostat R, placed in series with the shunt field of the exciter.

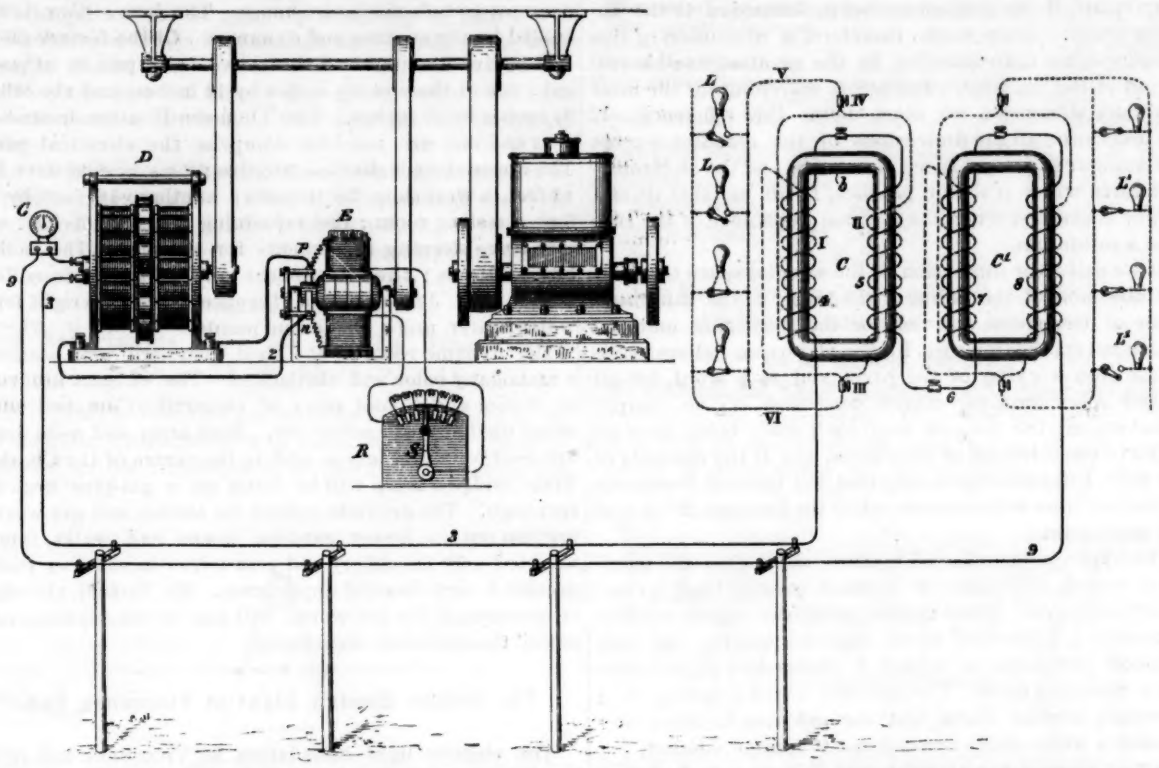


FIG. 2.—THE GAULARD AND GIBBS SYSTEM OF DISTRIBUTION BY SECONDARY GENERATORS.

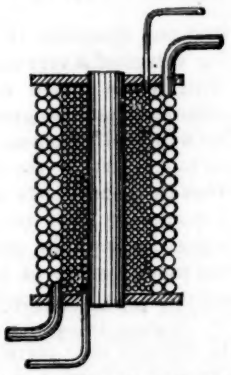


FIG. 1.—CONVERTING COIL.

In explaining the saving in conductors effected by this system we may best quote from the patent, as follows:

"Let it be assumed that we have an electric lamp, as L, Fig. 2, so constructed as to work at maximum efficiency when rendered luminous by an electric current of one ampère. Let it also be assumed that, for economical or other reasons, it is desired to employ an alternate current of 0.5 ampère only in the primary circuit. The necessary increase in the quantity of the secondary current will in such case be effected by the apparatus when arranged precisely as shown in the figure, for as the primary conductor of the converter C is connected in series, while the secondary conductor (with an equal number of convolutions situated in the same magnetic field) is arranged with one-half its convolutions in multiple arc with the other half, the result will be precisely the same as if the actual number of convolutions of the secondary conductor were only half as many as those of the primary. The total resistance of the secondary conductor, when thus connected, is obviously only one-fourth as great as that of the primary, the secondary being double the cross-section and virtually only one-half the length of the primary.

"When an electric current of alternating polarity is caused to pass through the primary conductor of the converter C, it creates by electro-magnetic induction a magnetic field, the intensity of which within the ordinary limits of working is proportional to the current (expressed in ampères) passing through the conductor. Each alternation so produced in the magnetism of the field tends to set up a definite electromotive force in each separate convolution of any conductor traversing the field. In the primary conductor this electromotive force opposes itself temporarily to the primary or magnetizing current; but as it is of inferior and rapidly-decreasing potential it acts merely to delay, and not to prevent, the magnetization of the field. An approximately equal electromotive force is at the same time set up in each convolution of the secondary conductor; but as the latter (in the present example) makes only half the number of convolutions within the field, the total electromotive force of the secondary current will be only half that of the primary current. Inasmuch, however, as the value of any current is expressed by the quotient of the electromotive force divided by the resistance, and as the resistance of the secondary coil is only one-fourth that of the primary, the actual number of ampères in the secondary current will be approximately twice as many as in the primary current. Strictly speaking, however, the inductive action may be said to be determined not by the number of convolutions, but by the extent of conductor, measured in linear units, which is in inductive relation to the magnetic field, assuming the lines of force in such field to be uniformly distributed. In order to produce a proper result, it is preferable that the resistance offered by that portion of the linear conductor in the magnetic field which is traversed by the primary current shall exceed the resistance of the conductor in the same field traversed by the secondary current in an inverse ratio to the increase in current strength or reduction of potential which it is desired to effect."

We may add that an experimental circuit several miles in length has been in operation for some time in Pitts-

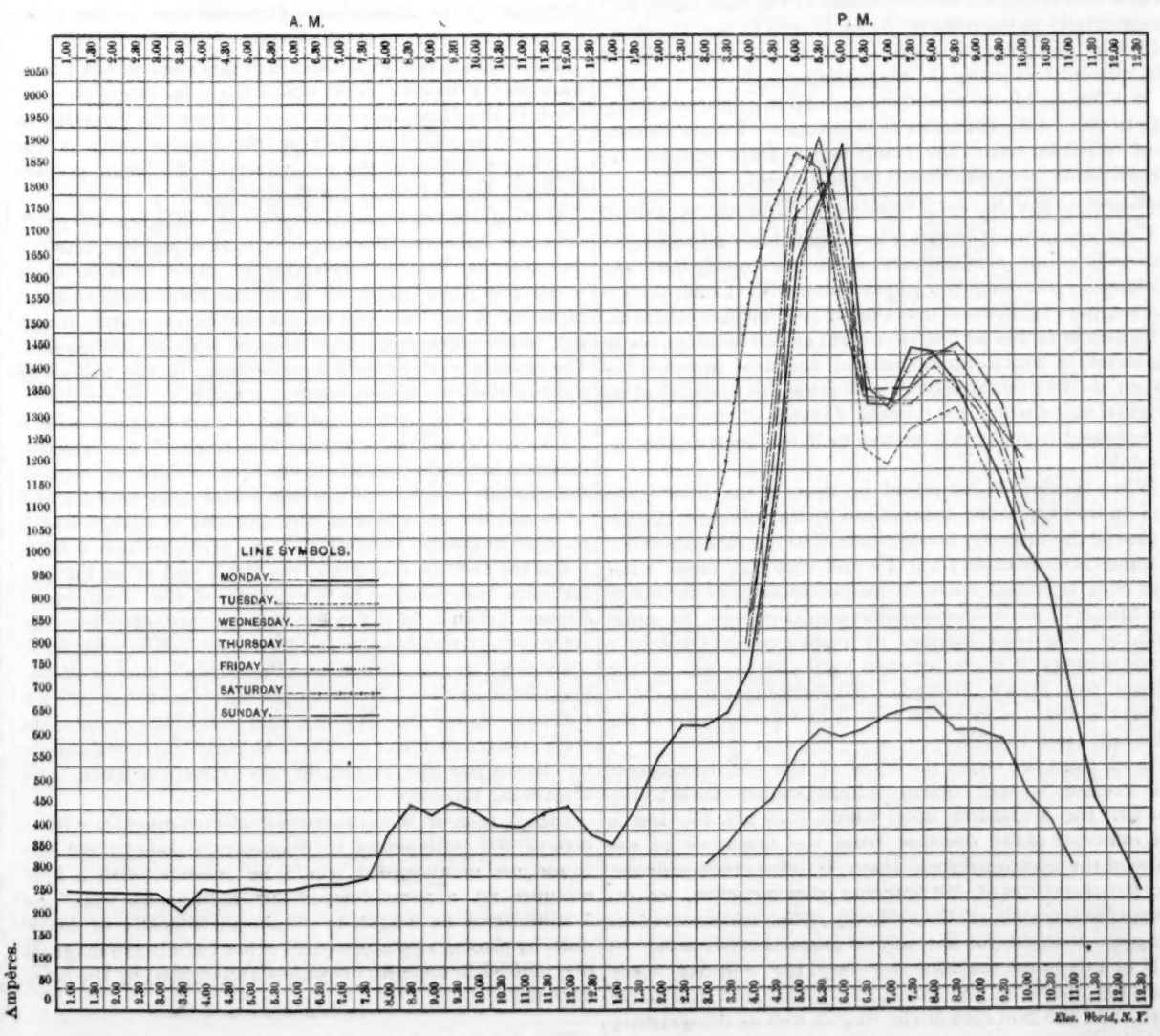


DIAGRAM SHOWING FLUCTUATION OF CURRENT IN EDISON CENTRAL STATION, BOSTON.

burgh, and the first public operation of the system has been undertaken in Buffalo, N. Y., where the dry-goods store of Adam Meldrum & Anderson was last week lighted on this system.

On the Intensity of the Magnetic Field in Dynamo-Electric Machines.*

BY MARCEL DEPREZ.

The most important element of a dynamo-electric machine is the magnetic field, and we may even say, "as is the magnetic field, so is the machine." This is true, contrary to the opinion of certain electricians, as well when the machine serves as a receiver as when it is employed as a generator. The magnetic field itself comprises two elements, volume and intensity, which in different degrees constitute its useful qualities. It is evident, in fact, that a field very extensive, but of very little intensity, like that of the earth, can render no useful service, and that a field extremely intense, but very small, like that obtained on bringing the opposite poles of a powerful magnet almost into contact, can be employed usefully only under very restricted circumstances, since the conductors destined to come within the action of this field can themselves have only a very small volume.

If in a dynamo machine we have given all the dimensions of the field magnets, as well as the intensity of the current circulating in their coils, leaving variable the extent of the polar enlargements as well as the distance separating them from the iron core of the induced ring, the volume of the annular magnetic field comprised within these two parts, and in which the induced wire moves, may be easily calculated with all accuracy, but it is not the same with the intensity of the field, which varies according to laws impossible to calculate theoretically. We can merely say that it is natural to think that it decreases if we increase the extent of the polar expansions or the distance which separates them from the iron core of the induced ring.

To elucidate this question, I have undertaken a long series of experiments under very varying conditions. I have operated upon electro-magnets of three different sizes, whose iron cores had the respective diameters of 200, 90 and 60 millimetres, and in each of them I have measured the intensity of the field comprised: (1) between the opposite poles of two identical electro-magnets, both energized by the current, and (2) between the poles of the electro-magnet and an iron armature submitted to its influence.

The intensity of the field was inferred from the measurement of the effort exerted perpendicularly to the lines of force upon a movable conductor traversed by a continuous current. I caused to vary, for each of the types of electro-magnets submitted to experiment, the dimension of the field taken in the direction of the lines of force, that is to say, the distance of the magnetic surfaces between which it is included; the dimension of the field taken perpendicularly to the lines of force, that is to say, the magnitude of the polar expansions, and lastly, the intensity of the current traversing the magnetizing coils.

It is impossible to reproduce here all the figures belonging to these different series of researches. I must be content to put on record the fundamental facts which these experiments have established beyond doubt.

Influence of the Mutual Distance of the Magnetic Pieces.

Contrary to what certain electricians have affirmed, *the intensity of the field decreases much less rapidly than the distance of the magnetic pieces increases.* I cite, for instance, the experiments made upon two electro-magnets, with two branches having iron cores of 200 millimetres in diameter, in which the intensity of the field included between the two opposite poles still preserves one-half of its original value when the mutual distance of the two poles is increased from 7.5 millimetres to 75 millimetres, that is, ten-fold.

When the field is comprised between a magnetic pole and an iron armature, magnetized by its influence, the decrease of the intensity corresponding to the increase of the distance is more rapid; but it is still very far from what was once supposed, since, instead of being proportional to the square of the distance of the magnetic pieces in question, as has been affirmed by certain persons led by a crude analogy, it is greater even than the inverse of the square root of the distance. To render this more clear, when the distance increases from 1 to 4 the intensity of the field falls from 1 to 0.6.

In all cases the larger the cores of the electro-magnets the greater is the current which excites them; the thicker the armatures upon which they act, the less is the influence of the distance from the armature to the poles of the electro-magnet. *Hence, it follows that on bringing the armatures of the inducing poles very close, we increase the intensity of the field very little, while we reduce the place available for the induced wire almost to zero.*

If in a dynamo machine we vary the annular space comprised between the polar expansions and the outer surface of the iron core of the ring as well as the quantity of induced wire coiled upon the latter so as to fill the annular space as completely as possible without interfering with the free action of the machine, it is certain that the efficiency of the machine will vary with the dimension of the annular space; it will be null when this dimension is very small, because the insulating materials which surround the iron ring, as well as the material play which must exist between it and the fixed polar pieces, will absorb all the available space and leave no place where the induced wire may be introduced. It will be, if not null, at least very small, if we give an excessive dimension to the annular space. There exists, therefore, a dimension of this annular space corresponding to the greatest possible efficiency of the machine. But before searching for the most favorable dimension we must define this efficiency. If we determine all the dimensions of the machine (except the annular space), its speed of rotation and the electromotive force which it should produce, I will say that its efficiency is greatest when the internal resistance of the ring is at a minimum.

If we call x the dimension of the annular space taken in the direction of the radius of the ring; a, the minimum value of the space allowed for the insulating material which covers the iron core, for the play-room indispensable to the free working of the parts, and, in a word, for all matter *other than the copper* conductor of the current coiled around the induced ring, such space being likewise taken in the direction of the radius, and H the intensity of the field, I demonstrate easily that the internal resistance of the machine is a minimum when the function $H^2 (x - a)$ is a maximum.

The experiments referred to above show that this maximum occurs for values of x much greater than is commonly supposed. These results, moreover, merely confirm those which I obtained about eighteen months ago with Gramme machines, in which I diminished the annular space more and more. The intensity of the magnetic field increased beyond doubt, but the machine became very decidedly worse as the annular space became smaller.

In machines of high tension such as those which I had constructed for the experiments at Creil, the value of the constant a is much greater than in machines of a low tension, because they require a far more perfect insulation.

Hence it results that the function $H^2 (x - a)$, reaches its maximum only for values of x very much greater than if a were small. This is the reason why I have been obliged to give the annular space so great a value in the Creil machines. This will readily appear if we know that the distance from the outer part of the induced wire to the polar pieces reaches in places 0.010 metre, and that the thickness of the insulating layer interposed between the iron core and the first layer of the induced wire was 0.0075 metre, this then made a space of 0.0175 metre entirely lost for the useful effect of the machine, so that if I had only given to the annular interval 0.020 metre, there would remain for the induced wire merely 0.0025 metre, that is to say, room enough to lodge a single layer of wire, the machine would not have yielded the eighth part of the electromotive force required.

Influence of the Dimensions Perpendicular to the Lines of Force.

I have made few experiments in this respect, but I have been able to ascertain that unless the polar pieces are very thick in the direction of the lines of force the intensity of the field is approximately in the inverse ratio of the developed surface of the polar expansions taken perpendicularly to the lines of force.

With an electro-magnet, the core of which was 200 millimetres in diameter, the magnetic field comprised between the poles has reached the value of 15,400 C. G. S. units when the polar pieces of a square form measured 200 millimetres per side and were 3 millimetres apart; it was still 11,400 units when the distance was 20 millimetres. The electric work expended collectively in the helices of the two electro-magnets amounted to 9 horse-power.

I proved, some years ago, that electro-magnets with a thick core were much superior to a group of small electro-magnets having collectively an equal weight as regards the absolute intensity of the field which they produce and of its volume, as well as of the quantity of energy which must be expended in their coils to produce such a field. I was the first to construct very thick and short electro magnets (experiments in the depots of the Northern of France Railway, in February, 1883) instead of employing electro-magnets of small diameter, long and numerous as was done in the Edison machine which figured at the Exhibition of 1881. My example has been followed with full success, and the magnetic field of the Edison machines since constructed has been considerably improved simply by decreasing the length of the electro-magnets and thickening the core.

I think that if we constructed electro-magnets with a core of 300 millimetres in diameter in place of 200 like those just mentioned it would be possible, with a field included in a parallelopiped 300 millimetres wide and 5 millimetres in height, to obtain an intensity of 20,000 units by placing opposite to each other two electro-magnets magnetized in opposite directions and excited by the same current.

* *Comptes Rendus.*

The Jubilee of the Telegraph in England.—It may not be generally remembered that next year is not only the royal jubilee, but is also the jubilee of the electric telegraph in England. The first practical electric telegraph was worked between Euston Station and Camden Town, London, on July 25, 1837.

Electric Lighting at Waltham, Mass.

A correspondent informs us that the electric light station now being erected by the gas company at Waltham, Mass., will be in operation by Dec. 10. The station will be one of the best equipped in the country. It consists of a two-story brick building, 40 feet by 45 feet, which does not include the boiler house. The lower floor is occupied by the engines and dynamos. Of the former there will be five Armington & Sims, two being put in at present; one of these is 10½ inches by 12 inches, and the other 9½ inches by 12 inches. Two Thomson-Houston incandescent and one arc machine comprise the electrical part. The upper story is divided into five rooms, one 22 feet by 43 feet, a workshop for repairs; another, 16 feet by 12 feet, a testing room; the remaining room is divided up into three sleeping apartments for the men. The boiler house adjoins; the retort-house and mill contain a Zell boiler with Jarvis patent furnace, a Wainwright feed water heater, and a Dickinson pump.

The dynamo room is sheathed with hard pine, stained a mahogany color and shellacked. The circuits are run on 35-foot and 45-foot poles of chestnut, Campbell wire being used almost exclusively. Mast arms and pole iron are used for street lamps, and in the centre of the Charles River bridge a lamp will be hung on a gas-pipe arch 30 feet high. The grounds around the station and gas-works are laid out in flower gardens, lawns and walks, intermingled with shrubbery and pear trees; in summer these present a very cheerful appearance. Mr. Tarbell, the superintendent of the gas works, will also be the superintendent of the electrical department.

The Heisler Electric Light at Vincennes, Ind.

The electric light installation at Vincennes has now been in successful operation for several weeks. The system employed is that of the Heisler Electric Light Company, of St. Louis, and consists in placing low resistance incandescent lamps in series. In order to obtain the best effect, the company contracted to place at each street intersection one lamp of 30 candle-power, which was intended to give equal illumination to that of two gas lamps of 15 candle-power each; but the result proved that the one electric lamp made a stronger and better illumination than the two gas lamps, although costing the city less than one-third what the gas costs—the city saving the cost of lamps and posts besides. Plain print can be read at a distance of nearly one hundred feet from the electric lamps and a good strong light is thrown more than twice that distance, which laps over the rays from the lamp at the next intersection, thus making a perfect illumination.

The station of the Vincennes Electric Light and Power Company, who are operating the system, is said to be a substantial one in every respect. Besides the city itself, the suburbs, Frenchtown and North Vincennes, are lighted by 100 lamps on circuits nearly eleven miles in length.

The "Transformer" in the Patent Office.

To the Editor of The Electrical World:

SIR: During the year 1882, being then in Boston, Mass., I carried out a series of experiments upon the use of the induction coil for the purpose of supplying electrical energy from central stations. As a result of these experiments I made an application to the United States Patent Office. The application was filed on the 29th of January, 1883, and contained complete description of a system in which alternating or undulating currents of high tension, generated in a central station, are used in combination with induction coils which transformed the electric energy conveyed by the mains into a number of currents of low tension and large quantity. Various arrangements were described and shown in the drawings.

The substance of this rather lengthy application may best be seen from one of its claims, which reads literally as follows:

"The combination in a system of electrical distribution of a generator adapted to produce electric currents of high E. M. F., a continuous conductor, including the primaries of a series of inductoriums and forming an internal circuit for the said generator, and a series of secondary circuits, each including one or more electric lamps, and formed of the secondary circuits of the said inductoriums, whereby the high tension currents flowing in the main conductors and primaries are enabled to develop secondary currents of low tension and great volume in the secondary circuits substantially as and for the purpose described."

The application was rejected and the objection of the Patent Office commenced as follows:

"Applicant should demonstrate more clearly to the office the possibility of producing quantity currents from intensity currents by means of an induction coil; it is not apparent how applicant in any case can get more quantity from a secondary coil than he has in his primary."

I now find that a patent has been granted to Messrs. Gaulard and Gibbs on the 26th of October, 1886, of which the first claim reads as follows:

"The hereinbefore described art or method of electrical distribution and conversion, which consists in establishing

in a closed electric circuit a current of alternate and equal positive and negative potential, producing by the influence of such current an inductive field of alternate polarity, and thereby inducing in translating devices situated in an independent closed circuit traversing such field a similar alternating secondary current of greater quantity and less potential than the originating or producing current."

It is quite apparent that the examiner in 1886 had a different view of the function of an induction coil than was the case in 1883.

I may also mention that in my experiments at that time I made use of a continuous iron core for the induction coil.

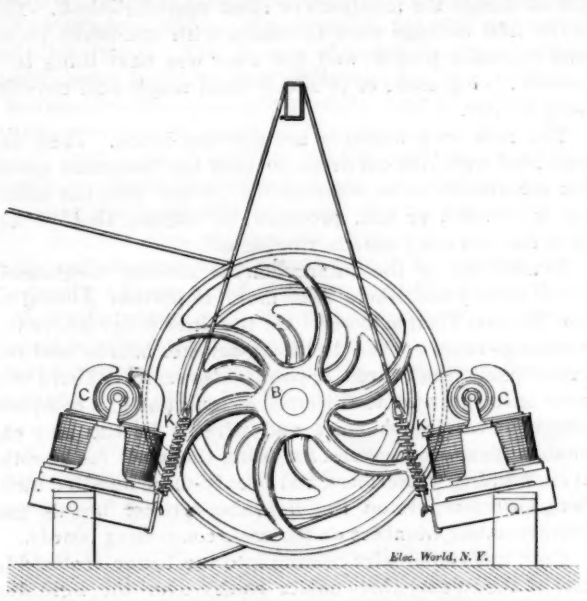
In the meantime I have made various improvements in regard to this system of electrical transmission, and I do not intend to relinquish my claim to priority in this matter.

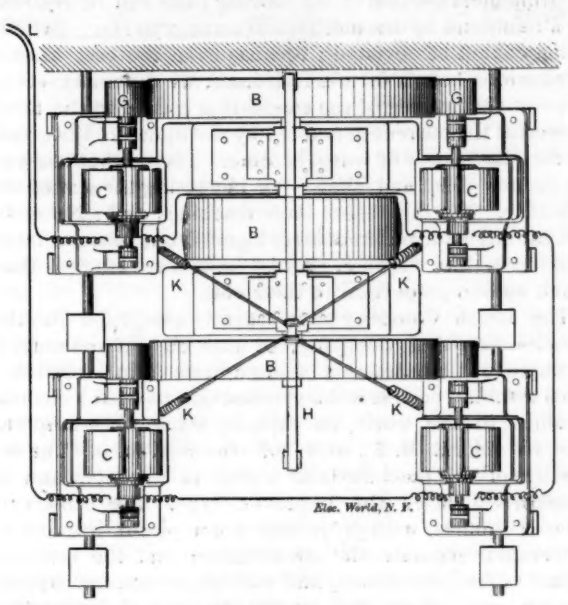
ALEXANDER BERNSTEIN.

LONDON, Nov. 17.

New Experiments Upon the Electric Transmission of Energy.

M. Hippolyte Fontaine has recently been engaged in experimenting with some new Gramme machines specially designed for the transmission of power. We gather the following details from a note upon the subject presented to the Académie des Sciences, by M. Mascart, upon the 26th of October: The experiments were carried out at the workshops of the newly-formed "Compagnie Electrique," which has been organized in Paris. The machines were constructed to the design of M. Gramme himself, and under his personal superintendence, the generators and motors being identical in type. Seven machines were employed, four of which were driven as dynamos, being connected in series to obtain high E.M.F., and the other three were employed as motors. The accompanying illustrations show the manner in which the test was carried out. The four generating machines *C* were driven by a friction wheel, as shown in elevation and plan in Figs. 1 and 2, and the motors *D* were coupled in the manner shown in Figs. 3 and 4. The latter were also coupled electrically in series, and their armature shafts were connected mechanically by means of a pair of Raffard's flexible couplings *F*.





FIGS. 1 AND 2.—ARRANGEMENT OF GENERATORS.—ELEVATION AND PLAN.

The armatures of these machines were of the ordinary Gramme type, the ring having a diameter of 30 centimetres, and a breadth of 35 centimetres, and being wound with 200 coils. The resistance between the brushes measured 4.75 ohms.

The field-magnets are of the single horseshoe type, of cast iron, and are so arranged that the whole frame of the machine, including "the core which receives the wire, the pole-pieces, and one of the plummer blocks," is cast in one piece. The resistance of the field-magnet coils is 6.65 ohms; the total internal resistance is therefore 11.4 ohms. From certain preliminary trials made with each machine separately, it appeared that a current of 11 ampères could be passed through the machine for twenty-four hours without excessive heating, and that an E.M.F. of 1,600 volts was the maximum that could be obtained before the efficiency began to diminish. To obtain this E.M.F., it was necessary to drive the machine at 1,400 turns per minute, which gives the somewhat excessive circumferential speed of 4,080 ft. per minute. "At speeds varying from 100 to 600 turns per minute, an electrical efficiency of 79 per cent. was obtained, and between 600 and 1,400 revolutions the efficiency increased to 81 per cent.;" it may be added that the latter figure is equivalent to a commercial efficiency of rather less that 75 per cent. calculated on the cold resistance of the coil.

An artificial resistance of 100 ohms was placed between the two sets of machines; the experiments, therefore, apply to the case in which the line wire has a nearly perfect insulation. The horse-power expended was calculated by taking indicator diagrams from the cylinder of the engine when driving alternately (1) the dynamos, (2) a Prony brake. In the absence of a reliable transmission dynamometer, and provided that the load upon the brake did not differ much from that upon the machine, this method is no doubt capable of a very fair degree of accuracy.

The following table refers to some experiments which were made with the machines:

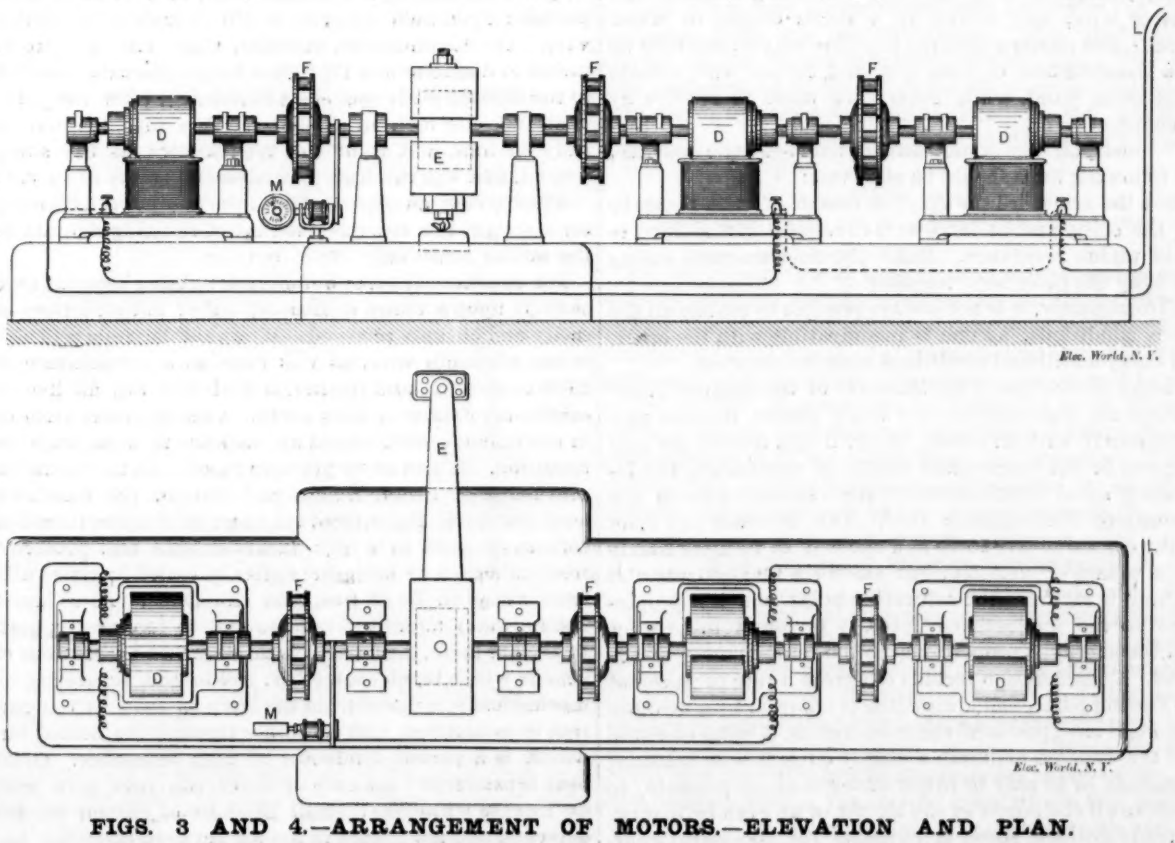
Revolutions of dynamos per minute	1,298
" motors " "	1,120
Difference of potential at the terminals of the four machines in series	5,996 volts.
Current	9.34 ampères.
Resistance of line	100 ohms.
Brake horse-power delivered on driving-shaft	95.88 h. p.
" " received " " "	49.98 "
Commercial efficiency	52 per cent.

The total weight of the seven machines was 8,400 kilogrammes, and the total cost 16,450 fr. This represents 167 kilogrammes per horse-power transmitted, at a cost for the machines of 2 fr. per kilogram.

On the Experiments Communicated by M. Fontaine on the Transmission of Power.*

BY M. MARCEL DEPREZ.

M. Fontaine has lately submitted to the Academy an experiment on the transmission of power by electricity, by means of a process which he considers novel, and which consists in substituting for the generating and the receiving machines a collection of machines connected in series, and in such a number that the sum of their electromotive forces makes up the value which it is desired to obtain. In the experiment in question the number of generators was four, and the number of the receivers three. This idea is far from novel, and it has been proposed by all the electricians who have sought to obtain high tensions without having recourse to the construction of the special machines which I have been the first to realize.



FIGS. 3 AND 4.—ARRANGEMENT OF MOTORS.—ELEVATION AND PLAN.

As for the method employed by M. Fontaine to govern simultaneously the four rings of the generators, it much resembles that described in a patent which I took out on April 28, 1885, in which I gave precisely an example of the application of this procedure to a machine with four rings of 0.30 metre in diameter and 0.20 metre in length, like those of the machine which served for the experiments in the works of the North of France Railway in February, 1883. There was thus produced an apparatus each ring of which could give a force of 1,500 volts at 1,000 turns per minute, the internal resistance of a ring being 5.5 ohms, and the total resistance of the four field magnets being 15 ohms. The weight of the acting parts was composed of:

Soft iron	1,124 kilos
Copper	652 "
Total	1,776 "

On adding 600 kilos for the support, it will be seen that we had arrived at a total weight below 2,500 kilos for a machine with four rings capable of producing 6,000 volts and 10 ampères at the speed of 1,000 turns per minute. This is half the weight of M. Fontaine's four machines. These results admit of no doubt, since they are obtained by the addition of the effects of identical machines perfectly known.

But this project was not continued because the conditions laid down for the experiments at Creil were quite different. The machines of M. Fontaine revolved at the speed of 1,300 turns per minute, those at Creil made only 500 turns in the same time. The linear speed of the rings of M. Fontaine is 20.5 metres per second as against 7.5 metres for those at Creil. If I had given the latter a linear speed of 20.5 metres, they would have yielded an electromotive force exceeding 16,000 volts. The conditions are in no manner comparable, as will be seen, and if the Creil machines are heavy it is simply because only a very low speed is required of them, and nothing has been done to lighten them. If in the arts we were to compare machines among themselves, taking lightness as the main condition, the engines of torpedo boats would be far superior to those in factories, and yet the use of the latter is far more general, though they are much heavier per unit of power. The reasons for this preference are too evident to require explaining.

In this order of ideas M. Fontaine's expedient is the same as that of the manager of a factory, who instead of a single engine of 100 horse-power, moving slowly and surely, should prefer to employ four small engines of 25 horse-power each, moving at a very high speed, and acting upon the same shaft by means of mechanical transmission, having for their object the reduction of the speed.

*Comptes Rendus.

Telegraph Suits in Philadelphia

A special dispatch, of Nov. 29, from Philadelphia says: The lawyers representing the various interests in the litigation concerning the receivership of the Bankers and Merchants' Telegraph Company, came before Judge Butler, in the United States Circuit Court, to-day, and argued a number of motions in the cause. Col. Ingersoll, who represents the United Telegraph Lines Company of New York, which is deeply interested in the Bankers and Merchants' Company, asked leave, on behalf of Clinton P. Farrell, the recently appointed receiver of that company in this circuit, to bring suit for damages against the Western Union for the cutting of the Bankers and Merchants' wires. The application was granted. He also asked that the bill of complaint filed on behalf of the Farmers' Loan and Trust Company for foreclosure under the Bankers and Merchants' mortgage be dismissed. A decision as to this was reserved.

Messrs. Turner and McClure, of the New York law firm of Turner, Lee & McClure, who represent the trust company, asked that the appointment of Mr. Farrell as receiver be set aside. It was urged that he was related by marriage to Col. Ingersoll, and therefore could not be con-

sidered as a disinterested party. Col. Ingersoll contended that Mr. Farrell was in every way fitted to fill the position, and that the question of relationship ought not to be taken into consideration. This was held under advisement.

Progress in Electric Lighting.*

BY N. S. POSSONS, MEMBER OF THE CIVIL ENGINEERS' CLUB OF CLEVELAND.

I recently had occasion to send an expert to erect an electric light plant in the yards and repair shops of a railroad company. The superintendent was one of those capable men who desired to learn all particulars relative to the apparatus, and yet was so fearful of the machine you could scarcely get him near it, for he said "The Almighty grappled for a time with electricity, and failing to control it, sent it into the world for man to wrestle with." The romance of our day consists of the wonderful performances of electricity and steam, far outrivaling the deeds of the past; and to this topic to night, in so far as it relates to electric lighting, I propose to call your attention.

Every mechanic has a fair idea of the almost endless variety of mechanical combinations by which electric light can be maintained, and the lively interest taken by the public in the development of this science is found in the fact that scarcely a month passes but some new system buds into existence. That some companies have a profitable career before them is not an open question; that others will regret that they have rushed after electrical apparatus with less judgment than enthusiasm is equally certain.

The interest excited by the present active progress in invention has caused us to overlook in a measure the early period of forty years ago, when many inventors' attention was turned in the same direction. The names of Staite, Wright, King and a few others are well known, but works recently published fail to bestow upon them their full meed of praise; but it is a recognized fact that many patents of an early day clash dangerously with some modern inventions.

The principal reason why the inventions of the early days failed was the want of a cheap and practicable dynamo; the earlier means employed for generating currents being from batteries. The earlier savants, Elias and Pacinotti, did not dream of generating currents from their machines, but only of utilizing the current to generate motive power, although the motor constructed might have been made available for the former.

The author then proceeded to give a very clear and accurate statement of the principles involved in the generation of current by dynamo-electric machinery. Coming to practice, he said:

The principle which governs the conversion of mechanical into electrical energy, or the production of electric currents, I will endeavor to explain in a simple way. All know, who have given the subject attention, that electric lights are produced from powerful currents of electricity generated in a machine containing magnets and coils of wire, and driven by a steam engine or water wheel. The modern dynamo machine may be summed up as a combination of cast iron and copper wire, certain parts being fixed, while others are made to revolve by mechanical force.

To construct, then, a successful dynamo-electric machine, the following lines should be observed:

Give the armature the greatest length of wire comprising the coils, and as large as is consistent in diameter, to avoid undue resistance. Make the field magnets strong and keep the poles near together.

Unfortunately, it is not always possible to realize all the above conditions, as one is incompatible with the other, and many additional conditions must be observed.

Theory shows that if the intensity of the magnetic field be constant, the electromotive force should increase proportionately with its speed. Now, if the iron in the field magnets be not magnetized nearly to saturation, the increase of speed produces nearly the same increase in the strength of the magnetic field. This increase will react on the electromotive force and cause it to be more nearly as the square of velocity; but since the magnetization of the iron is far from the saturating point and not proportional to the magnetizing force, it is found in practice that the energy is proportional to the fourth power of the speed. Consideration forbids too great a rate of speed of the moving parts, and a safer line is followed by a medium speed and most powerful electro-magnets, it being essential that the dynamo maintain a steady current with constant potentials, or as may be better understood, by pressure, to preserve all the lamps in the circuit of an even brilliancy. A steady uniform speed is requisite for successful lighting, a gas engine being out of the question; we need the best sensitively governed steam engine or good water-power.

We can, perhaps, make far closer measurements in electrical matters than is generally understood. A convenient system of describing the capacity of a dynamo by experts has been based upon the fact that the output of electrical energy is found by multiplying the quantity of current (designated ampères) and the difference of potential through which it is moved. This being expressed in volts, the product will be a certain number of volt-ampères, or, as is more usually termed, watts. Since 746 watts equal one electrical horse-power, to this we must add the resistance of the dynamo machine, the friction of bearing, and thereby arrive safely at the actual power absorbed at the pulley of the machine.

Taking incandescent lamps as now manufactured, a 16 c. p. lamp requires approximately 55 watts. Thus, you will note, for every indicated horse-power we obtain 13 lamps, or 10 lamps per net h. p.

Again with lamps (arc) of 2,000 c. p. and ten ampères of current and 45 volts of potential, we have about 450 watts, of about four-sevenths of an electrical horse-power.

There is an enormous difference between the relative capacities of machines of different types. Great improvements have been made of late in the capacity of machines, and especially in improving their capacity relatively to the weight of copper in the armature.

Mr. Brush in 1884 increased the capacity of his machine fully 47 per cent., by abandoning the cast-iron ring armature, and substituting in its stead a ribbon armature built of thin ribbons of iron and insulating each layer. Every condition which contributes to the waste of energy of the current reduces the efficiency of the machine.

Mechanical friction of the moving parts can be reduced to a minimum by due mechanical arrangements. But one thing cannot be obviated; because even the best known conductors have a certain resistance, we cannot expect to prevent the heating of the conducting coils, and the more powerful the current generated by the dynamo, the greater does the source of waste become. There is but one way to reduce this, and that is by increasing the size of the machine. For this reason large machines are advocated, not for any admiration of mere bigness, but because large machines, like engines, may be made more efficient than small ones in proportion to their cost.

The Brush Company have recently completed for the Cowles Smelting Company, of this city, a mammoth dynamo for the extraction of aluminium from corundum. This machine possesses the greatest output of any electric machine in the world, its capacity being 3,800 ampères and 100 volts E. M. F., over 500 electrical h. p. The armature of this machine is 42 inches in diameter, and is constructed after the improved type. The ribbon is wound circular, with projecting cross pieces inserted at intervals to separate the convolutions and the better to admit of free circulation, and with projections as support for the coils. These coils, or bobbins, are 16 in number, and are wound in double layers with three-eighths inch copper wire. This ring is mounted upon a hub made from 10 per cent. aluminium brass, and weighed in the rough cast 400 lbs. This particular casting has a tensile strength of 67,000 pounds to the square inch, with an elongation of 5 per cent. The copper comprising the coils weighs 1,000 pounds, and the whole armature and hub 4,200 pounds. The shaft is made from Otis steel, and is 12 feet long by 5¼ inches diameter. The field magnets, of which there are eight, weigh in the casting 500 pounds each, or a total of 4,000 pounds; upon each magnet is 750 pounds of insulated wire. The commutators, of which there are two, are 10 inches in diameter and 12¾ inches long. The cables leading to the binding posts are eight in number, each composed of strands one inch in diameter. This machine weighs fully 10 tons, and is of the type known as the shunt wound, and will run 6,000 incandescent lamps of 16 c. p.

After giving an explanation of the manner of obtaining electric light in a circuit by the use of resisting substances, the author continued:

The commercial success of electric lighting depends then entirely upon a cheap resistance, either indestructible or easily and cheaply renewed. It would be impracticable to use platinum wire, as this fuses at a temperature of 2,000 degrees C., and further, if heated in air, all known substances oxidize or burn away. Carbon, either alone or in conjunction with heated air, satisfies in a measure the condition. It has never yet been fused. In the incandescent lamps of Swan, Edison and Maxim, the resistance used to convert the current into heat is of a fine thread of carbon, brought to a high incandescence and protected from oxidation by being hermetically sealed in glass bulbs from which all the air has been exhausted. These lamps last for many months if not brought to too great a heat. In the arc lamp, the current is through two carbon rods or pencils which touch each other, end to end, separating by mechanical arrangement in the lamp as soon as the current is established and continues through the heated air, which is a partial conductor of high resistance. Great heat is produced; the ends of the carbon rods glow with an intense whiteness; small particles of carbon become detached and are heated in the air between the poles and form an arc, which adds to the light. The carbons consume slowly away and are fed by gravity. As this arc becomes long the resistance increases; the electro-magnets become weakened, and the rod is released by mechanical means and the carbons feed.

In describing machines and lamps I have endeavored to give a general idea, not confining myself to any particular system, some of which I regard as good, others actually bad, in order that an idea of the science may be brought to your notice. The possibilities of electric lighting are very great, and I firmly believe that the day of universal electric lighting will be in the near future, and hope to see in every house the incandescent lamp. For while we may have seen failures in the past we have also seen the steady growth of success. Invention after invention has stood the test, not in its experimental stage, but after months of trial.

* Abstract from paper in the *Journal of the Association of Engineering Societies.*

The New Telephone Exchange at Cincinnati.

The fitting up of the new telephone exchange in Cincinnati, under the management of Capt. George N. Stone, is now complete. The exchange has been in course of construction for several months. In describing the opening of the new "central" in the Masonic Temple, the Cincinnati *Times-Star*, of Nov. 21, has the following:

In the commodious new exchange, last night, a scene was presented that cannot be duplicated in any other telephone exchange in the world. It was one of convenience, of luxury and of taste. On the north side of the room were seen a long line of multiple switch-boards made of mahogany and all illuminated with electric light, and all presided over by the nimble-fingered attendants, whose business it is to answer the "hello" calls. Opposite the multiple switch-boards was a multiple board for toll-line connections only, and on the middle of the west end of the exchange the monitor's or chief operator's desk. The walls and ceilings were decorated with handsome paper and lincrusta walton, and the floor was next thing to a mosaic, being made of two-inch hard maple and covered with shellac.

The new switch-boards are the very latest. They are provided with ring-off drops so that the telephone operator can always know whether the person who has called up is through or not, provided, of course, that person uses the necessary care in ringing off.

In addition to the improvements already mentioned, the company has others still more important located in the Masonic Temple tower. On the three floors above the exchange room are the lightning-arrester boards and the cross connecting boards, appointments scarcely heard of a year or so ago, and now deemed as essential to a complete telephone service as poles and wires. In the new exchange there are facilities for doing the work for twenty-three hundred subscribers, and twenty-three hundred numbers, therefore, are on the lightning-arrester boards, and corresponding numbers on the cross connecting boards.

Each individual wire coming into the tower inclosed in one of the twenty-three cables passes over the lightning arrester. This consists of a delicate piece of gold foil about three inches in length, spread on paper and laid on a piece of wood which forms a connection between two springs or electric poles. If a current of lightning is on any one of the telephone wires and manages to jump the lightning arresters, which are located in the long boxes which can be seen mounted on the poles at the cable ends, anywhere in the vicinity of the exchange, it is pretty sure to exhaust itself by burning up this gold foil connection in the tower, breaking the connection on the wire, but doing no further damage.

Twenty-three hundred wires have been adjusted in this tower and 2,300 wires connected with the switch-boards of the exchange.

A vague idea of the tedious task and of the enormous expense can be formed from the fact that in the city proper, where the heaviest work of the telephone is done, all the old forty-five foot poles have been replaced by poles twenty feet higher and hard drawn copper wire strung on them.

The expense of this enterprise to the Cincinnati Telephone Company, including the cost of the necessary poles and best electric wire, and all other appliances, is not less than $100,000.

A Novel Arc Lamp.

In an arc lamp recently invented by Mr. E. A. Ashcroft, of London, Eng., the regulation is effected by the employment of an electromotor, having a revolving armature placed in a shunt circuit from the two terminals of the lamp. The carbons are separated by means of a weight, and an incandescent lamp is placed in the same shunt circuit as the motor, for counteracting the increased resistance of the motor wire due to the heating effect of the current. The upper carbon is carried by a toothed rack, with which gears a pinion on the motor spindle. This rack is suspended by a weighted cord passing over a pulley, the weight being greater than the rack cord and carbon, so as to draw the carbons apart. Upon closing the circuit, the current passes through the electromotor, which is set in motion, and effects the contact of the carbons. When this takes place, the difference of potentials between the lamp terminals is decreased, owing to the decreased proportional resistance of the lamp, and the weight raises the rack until the arc attains the normal length to which the lamp is adjusted. As the carbons are consumed the increased resistance of the arc causes an increased difference of potentials between the lamp terminals, causing more current to flow through the motor, which will then readjust the arc by driving the rack down until the carbons attain the normal distance. The increased difference of potentials also causes more current to flow through the incandescent lamp which is in the same circuit as the motor, and, by heating it, reduces its resistance, thus further adding to the sensitive action of the

motor. This goes on until the carbons are consumed, when the motion of the rack is arrested by a small stop pin.

On Diathermancy and Electrolytic Conductivity.*

BY SHELFORD BIDWELL, F. R. S.

The following is one of the questions suggested by Dr. Lodge for the consideration of the committee on electrolysis: Is there any relation between optical opacity and electrolytic conductivity?

Assuming that "optical opacity" is included in the more comprehensive term "opacity to radiation," I have endeavored to ascertain experimentally whether those electrolytes which transmit radiation with the greatest facility, as evidenced by the effect produced upon a thermopile, are also the worst conductors of electricity. I may say at once that this was undoubtedly not the fact, and the relation which was supposed to be possible does not exist.

Considerable time and care were bestowed upon the experiments, and every precaution was taken with the view of insuring accuracy. The thermopile used was a delicate one, containing 54 bismuth-antimony pairs; it was inclosed in a flannel-covered box, fitted with a pane of glass 1.5 mm. thick opposite the face of the pile. The galvanometer was an astatic reflecting instrument of .545 ohm resistance made by Elliott. The source of radiation was a small paraffin lamp, having a glass chimney about 2 mm. thick.

The parallel glass sides of the cells, used to contain the liquids, were 13 mm. apart and 1.9 mm. in thickness. A screen, with a small aperture, which could be instantly opened or closed by a sliding shutter, was interposed between the cell in use and the lamp. The various solutions were in every case exposed to radiation for a period of 30 seconds, and each observation was checked and standardized by the aid of a certain cell containing water. It is hardly necessary to describe the arrangements and method of observation in greater detail.

A few of the results, which, for the most part, need no comment, are given in the following table:

Solutions, etc.	Diathermancy.	Solutions, etc.	Diathermancy.
Empty cell	1.000	Zinc sulphate sol. sp. gr 1.157	207
Water distilled	197	Sulph. acid 1.032 (5 per cent)	208
" from tap	203	" " 1.225 (30 ")	216
Alum saturated solution	204	" " 1.638 (72 ")	292
Ammonium chloride solution	215		

The observations with sulphuric acid are the most instructive. It is well known that the electrical conductivity of sulphuric acid at first increases with the concentration, reaching a maximum when the strength of the solution is about 30 per cent., and afterwards rapidly diminishing. That there is no corresponding minimum diathermancy appears clearly enough from the above table, which seems to furnish a conclusive answer in the negative to the question proposed.

The diathermancy of a solution of zinc sulphate was almost independent of its strength, being nearly the same for a 5 per cent. as for a saturated solution. It was quite unaffected by the passage through the solution of a strong battery current.

A New Heat Battery.

Signor V. Riatti has constructed a somewhat novel arrangement for effecting the direct conversion of heat into electricity. He takes a rectangular vessel, tall in proportion to its sectional area. Two copper tubes are passed through the sides of the vessel, one near the top and one near the bottom; these tubes pass through from side to side without opening into the vessel itself. The latter is then filled with a solution of sulphate of copper, and a current of cold water is passed through the lower tube, while superheated steam under a pressure of several atmospheres passes through the upper tube. Under these circumstances, on closing the circuit with the two tubes as electrodes a current is obtained which passes externally from the cold to the hot tube, while copper is dissolved from the upper and deposited on the lower tube.

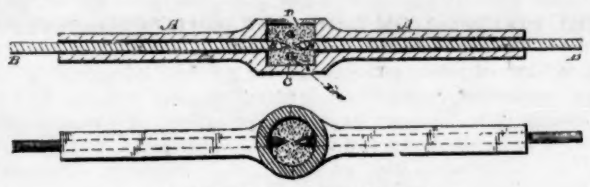
A Ghost at the Telephone.

I heard a story not long ago of an undertaker who was called up in the night by a ring which the central office operator said was from one of the great cemeteries, and the voice that called him was so strange that it made him shudder. It was wonderfully distinct, and yet so slow, so cold, so far away, that it sounded like nothing else that he had ever heard. It uttered not a single word except a long drawn out "Hel—lo! Hel—lo—o-o! Hel—l-o-o-o-o-o!" And the more he shouted back, the more that one ghostly call came over the wire to him. Dumbfounded at last, he hung up his telephone and sat down, but meditated uneasily, while the sound still rang in his ears. Then he jumped up and rang for the central office. "Give me No. —," he called out. That was the cemetery. Presently he had the connection. "Were you calling me just now?" he asked. "Calling you? Certainly not. Haven't called to-night." Then he objurgated the central office. "Certainly the cemetery did ask for you," said the operator, "and I made the connections." Next night the same call came, and the shuddering undertaker heard the same ghostly "Hel—lo-o-o-o" until he could bear it no longer. Then the same colloquy with the cemetery office and the central operator followed. I am told that the undertaker grew almost insane with the ghost call, as he soon began to regard it, and had the telephone taken out of his shop, to the great detriment of his trade, but that he afterward had it replaced, and, though he has not since been called up by the voice from the other world, he sits in nightly dread of it.—*Boston Post.*

* Communicated to the British Association.

A Novel Electric Lamp.

A number of substances have been employed as the incandescing medium in electric lamps both in the arc and incandescent types. Thus we have the well-known carbon; lime or marble as in the French "lampe soleil;" and zirconia has also been employed in some instances on account of its great brilliancy when highly heated. A novel arrangement of the zirconia electric lamp has recently been devised by Messrs. Darius Lyman and Marshall Wheeler, of Washington, D. C., and which we



A NOVEL ELECTRIC LAMP.

illustrate in the accompanying engravings, Figs. 1 and 2, which represent respectively a vertical longitudinal section and a plan view of the same.

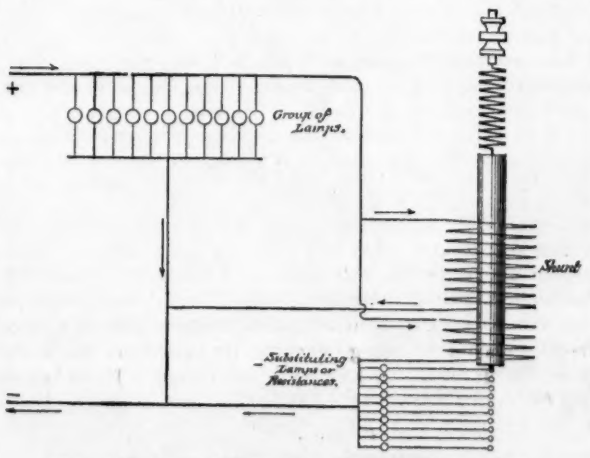
The lamp-holder *A* is made of platinum or other heat-resisting material, and is perforated at both ends so as to permit the passage of the wires *B*, which are insulated from the holder. At the centre of the latter there is a cavity *C*, which is filled with amorphous zirconia, either in a powdered or compressed state. There should be sufficient zirconia in the pocket or recess *C* to give an amount of light in comparison to the force of the electric current which is passed through the two wires *B* and through the zirconia. If the zirconia is placed in a loose form in the pocket or recess *C* it can be securely held in place by the use of a disc *D*, which is also made of zirconia solidified to a suitable extent. As the tips of the wires *D* do not touch each other, the current passes through the body *G* of the zirconia, which becomes highly heated and throws off an intense light.

As the holder is shown in the illustrations, the pocket or recess is open upon its upper side only, and hence the light will be reflected upward if turned in that direction, and a reflector of some kind is necessary in order to deflect the light downward and obtain the best results. If the holder is turned so as to have the open end of the pocket extend in any other direction than upward, the light will be projected in that direction in which it is desired to throw the light. According to the inventors, the form of holder shown is best adapted for household purposes, for the reason that the light is thrown upward against the ceiling, and will be reflected back in a soft diffused form, which especially adapts it for use in a room.

Incandescent Lighting from Arc Circuits.

To the Editor of The Electrical World:

SIR: In THE ELECTRICAL WORLD of Nov. 20, 1886, there appeared a paper by Mr. Frank Ridlon on "Incandescent Lighting from Arc Circuits." Allow me to ask a few questions, and to call the attention of this gentleman to a few facts of which he seems to have been ignorant or to have overlooked.



INCANDESCENT LIGHTING FROM ARC CIRCUITS.

In regard to the operation of the distributor box the writer states its action very simply, viz.: "The two solenoids or coils on the right and left of the box are so adjusted that when all the lamps are in operation the spindle in continuation of the armature will rest lightly on the top contact or spring, the circuit of resistances being then open. If, now, a lamp be turned off or breaks, more current will be shunted through the solenoid of that side, and the armature be further attracted within the core and cause the top contact to touch one beneath it, then closing a circuit through one resistance, taking up the current of the broken lamp and preserving the balance of the circuit. If another lamp be turned off the armature will be still more strongly attracted and depress the first and second strips so as to make contact with the third, thereby switching in a second resistance equivalent to a lamp, and so on, until all the lamps are put out of circuit and all the resistances thrown in."

From cuts in advertising columns and from further remarks of the writer I should judge that the action of each solenoid is to take charge of the 50 volt groups. Both solenoids, when in series, adapt themselves to 100 volts. Supposing, now, we have 10 lamps burning on a 50 volt 10 ampère circuit, and one lamp fails, the difference of potential rises to 55 volts, the solenoid becomes more excited and draws in the core so as to bring the first spring in contact with the second, thus cutting in the substituting resistance or lamp.

This will have the effect of lowering the difference of potential to the normal 50 volts. What now prevents the solenoid core from returning to its former position which it held with 50 volts? There is apparently no reason why it should not fall back, again causing an increase to 55 volts and keeping up this continual see-sawing, very much like the action of a centrifugal ball governor on a steam engine. The result would be a continual flickering in the lamps. In the United States patent No. 345,561, granted to Mr. Merle J. Wightman, a description is given of a distributor box used by the Schuyler Electric Light Company. A model made in January, 1885, embodied the very same feature of contact making as described by Mr. Ridlon, and is shown in the drawings. In this distributor box the necessary additional pull for holding the core in its new position is obtained from the current passing through compensating resistance and a compound coil wound round the shunt coil. The accompanying sketch will show the arrangement clearly. By inserting a new lamp in place of the broken one, the difference of potential being lowered to 45 volts, the core is allowed to go back, thus cutting out the additional resistance and restoring the normal difference of potential of 50 volts. Of course the compound action is taken away with the cutting out of the resistance.

The first of these distributors was put on the market on February 19, 1886, and nearly 200 have since then been supplied to the different plants of the Schuyler system. Mr. Ridlon seems to be ignorant of even the existence of such a device outside the Sun Company of Woburn, Mass. Moreover his so-called ideal series system has been in practical operation in the Schuyler Company's stations for more than half a year. In this system no substituting resistances are used. Each incandescent lamp of any candle power desired is looped in any arc circuit of from 6 to 10 ampère current in exactly the same way as an arc lamp. There is necessarily a respective diminution in volts, according to the candle power. An effective safety device patented November 16, 1886, is contained in each lamp and cuts out the same after failure without interfereing with the remainder. [See this week's Illustrated Patent Record.]

The Edison Company has also made a similar attempt to light stores with incandescent lamps in series but with not more than a 4 ampère current. This application, known as the Edison municipal system, has, under the able management of Mr. W. J. Jenks, given very satisfactory results for street lighting in Portland, Me., and elsewhere.

HERMANN LEMP.

HARTFORD, CONN.

American Institute of Electrical Engineers.

The above society will hold its first dinner and special meeting of the season at Cable's restaurant, 130 Broadway, on Dec. 7, at 6 P. M. The subject of discussion will be "Electric Street Cars," a matter of practical and immediate importance in all our cities. The opening paper will be presented at 7:30. Members are at liberty to invite friends, and any non-member desiring to attend the dinner should communicate with Mr. Ralph Pope, the secretary, 16 Dey street. The meeting is open to all interested in electrical matters, and promises to be one of great interest.

The Blackpool Electric Tramway.

A correspondent of a foreign contemporary, who has visited Blackpool, writes: "The electric tramway opened at Blackpool over a year ago has proved a great success. In order thoroughly to investigate the undertaking, a number of gentlemen visited Blackpool the other day and made a thorough inspection of the line. They were first taken over its whole length of two miles in one of the six cars running daily. The facility with which the vehicle was stopped to take up and set down passengers, and its speed accelerated or reduced, showed a more complete control than that over cars moved by horse-power. The line has now been opened for traffic nearly a year, and no accident or delay has occurred in its working. Some of its carriages carry fifty-six passengers, and, while fully loaded, have drawn or driven along the line as rapidly as if drawn by steam, accomplishing the two miles in twenty minutes. As to the financial part of the enterprise, it was ascertained that the cost per mile run was but 4d., and the revenue had reached 2s. 6d. per mile run. This, of course, was during the season. The company will, it is expected, declare a dividend of 5 or 6 per cent. this year.

NEW YORK NOTES.

Office of The Electrical World,
Nov. 29, 1886.

The Mather Electric Company issued recently a list of plants that it had put in operation up to Sept. 1, 1886. The list includes forty-nine plants scattered all over the country, and foots up several thousand arcs and incandescents. I notice that in some instances as many as three and four orders have been sent in by a single concern buying the plant—pretty good evidence that satisfaction has been given. You have from time to time chronicled the various installations mentioned, and now, taken together, they are an indication of great activity as well as of solid growth.

Messrs. Hughes & Browning have recently established themselves as contracting engineers for the Edison United Manufacturing Company, devoting their special attention to the business of isolated lighting, etc. Their main office is at Syracuse, N. Y., and they control the district comprising New York State (excepting New York City), Connecticut and Rhode Island. Since Aug. 14 they have placed 4,500 lamps in 21 different plants. Among the latter are included 75 lights for Albany Perforating Wrapping Paper Co., 150 lights in Hinckel's brewery at Albany, and 150 lights in the Bridgeport Paper Company's mill.

In my mention last week of the fine new Excelsior plant at Canandaigua, the number of poles was given as 126. It should read 526.

W. J. Moran, of 740 Greenwich street, amuses himself by giving away, at the Institute fair, sample tins of his engineers' metal polishing paste for engines, lubricators and the like. The effects of its use, as far as I have seen, are excellent, and I believe it would have kept many a dynamo room spick-and-span. Perhaps it might not increase the efficiency of a dynamo, but I have noticed that the men who keep the machinery in their charge bright generally get a greater output from it than those who are content with dirt and dullness.

Progress continues to be reported in subway operations. The Averell system is to be put down in the cross-town section on Fifty-eighth street, and is now, it is said, likely to be adopted for some of the work lower down in the city. The Western Union Company has paid its assessment of $11,000, and it is now thought that other companies will also "come in," rendering unnecessary the issuance of any taxation warrants by the Comptroller.

W. T. H.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
Boston, Nov. 29, 1886.

The next meeting of the Society of Arts will occur on the evening of Dec. 9, at the Massachusetts Institute of Technology.

Some excitement was caused in Malden, Mass., last Wednesday evening by an effigy of a man suspended on one of the telephone wires.

Advices from Salem, Mass., report the arrival in that city of twenty-nine bundles of No. 12 copper wire for the Pearce & Jones electric fire alarm. It is predicted that the alarm system will be completed by January 1.

The telephone at the Ocean View House, Juniper Point, Salem, will be removed Monday, as the city refuses to pay any part of the expense. This cuts off all telephonic communication at the point. An effort was made to have the city maintain this for a fire alarm. The City Council committee will also report against allowing Juniper Point any night watch, as petitioned for. The Lynnfield telephonic connection has also been cut off.

A dispatch from Gloucester, Mass., dated Nov. 24, states that: "The United States Fish Commission schooner 'Grampus,' which fouled the United States telegraph cable a short time ago on Brown's Bank, losing her anchor in order to save the telegraph cable from damage, has been reimbursed for the loss by the cable company."

The directors of the Mexican Telephone Company held a meeting in Boston on the morning of November 26, and appointed a committee to look into the affairs of the corporation. They believe, it is said, that the investigation will show that the company has not suffered a heavy loss by the irregularities of the defaulter Reed. It will be remembered that Reed is reported to have stated positively that the affairs of the Mexican Telephone Company, of which he was treasurer, were all right. It appears that there had been an overissue of the company's stock to the extent of 9,800 shares. Mr. Arthur E. Denison, one of the directors, said that it was done by Reed as treasurer with certificates of stock signed in blank by the president. Mr. Denison did not think the company would lose much, or that its standing would be impaired by the overissue, for the company owed Reed considerable money advanced for construction, etc., and it was probable that an equalization of accounts would show a deficit of only $1,500 or $2,000.

The American Telephone and Telegraph Company of New York, which is the subsidiary corporation under whose immediate control the new long-distance service of the American Bell Telephone Company is being organized (see The Electrical World, Nov. 20), has a line between New York and Philadelphia ready for business, and is now constructing a very heavy line from New York to New Haven, Providence and Boston. Next season it will build a similar line from New York City through the interior cities of the Empire State to Buffalo. As a result of the experience which has been obtained in the experimental tests of this long-distance service, the Philadelphia line has been constructed of 24 heavy copper wires strung upon poles that are capable of carrying 70. The new line to Boston is expected to consist of 50 copper wires.

At the request of the State Treasurer of Massachusetts, a suit has been brought by the Attorney-General against the Western Union Telegraph Company. A bill was filed in the State Supreme Court last April to enjoin the company from doing business in this State, because it has not paid any taxes for the year 1885. The amount was $10,618, which was due Nov. 2. As it is a foreign corporation, the company removed the suit to the United States Circuit Court, and there filed an answer, admitting substantially all allegations in the bill of complaint, but claiming that the company really owed only a small fraction of the tax, because most of its lines are upon railroads which are declared post roads by Congress, or are over or under navigable waters which are in the jurisdiction of Congress. The hearings in the case will be had before Franklin F. Fiske. Should the corporation be exempted on the ground that its lines are on post roads, the steam railroads might be exempted for the same reason, it is said. Assistant Attorney-General Shepard is conducting the case in behalf of the State, and George S. Hale for the telegraph company.

The Newburyport, Mass., Gas Company has petitioned the Legislature for the right to furnish electric lights in that city and vicinity.

There is a rumor current in Boston that two of the leading local electric light companies (Brush and Merchants) are about to consolidate.

The Bridgeport, Conn., Electric Light Company has ordered another Armington & Sims engine from the Jarvis Engineering Company, Boston; this making the seventh.

The Brush Electric Lighting Company of Boston has been given the order to furnish 20 incandescent lights in the Common Council chamber. The first cost of installing this small isolated plant will not exceed $400, and the estimated cost of special maintenance thereafter will be $7.20 per night.

Dr. O. C. Marden, of Boston, Treasurer of the Fort George Island (Florida) Association contemplates the purchase of a 300-light incandescent plant for the Fort George Hotel, one of the most popular of the Floridian winter resorts.

A letter of recent date received from Mr. L. I. Fletcher, agent of the Nashua, N. H., Electric Light Company, contains the following: "We are using at present one Armington & Sims engine of 60 h. p., one Jarvis boiler 80 h. p., one 45 arc light Thomson-Houston dynamo, and one 300 light incandescent (Thomson-Houston) machine. We are operating at present about 40 arc lights and 200 incandescents; and intend soon to increase the plant."

Mr. Lyman P. French, a prominent member of the Boston bar, has been elected manager and treasurer of the Sun Electric Company, of Woburn, Mass. Mr. Frederick Swift, the predecessor of Mr. French, recently resigned, owing to important business engagements in California requiring his undivided attention and necessitating a prolonged visit to that State.

Messrs. Goodnow & Wightman, the well-known Boston hardware dealers, are giving special attention to fine tools, castings and lathes for electrical purposes. Mr. Goodnow has made a study of the requirements of young electricians, electrical students and inventors of electrical apparatus, and has put in stock a full line of castings for dynamos and other apparatus.

The Wainwright Manufacturing Co., 65 and 67 Oliver street, Boston, and 93 Liberty st., New York, have recently supplied the following companies with their feed-water heaters: Middletown Electric Light Co., Middletown, Del., 30 horse-power; Easton Electric Light Co., Easton, Pa., 150 horse-power; Thomson-Houston Electric Light Co., Lynn, Mass., 400 horse-power; Birmingham Electric Light Co., Birmingham, Ala., 150 horse-power; Cambridge Electric Light Co., Cambridgeport, Mass., 300 horse-power. Electrical men generally are beginning to understand the desirability of these heaters, combining increased heating surface with reduced size, a result attained by the use of corrugated tubes.

The Tarbox Time Register Company, of Boston, has recently added improvements to its electric watch clock, making the apparatus, it is said, unerring in action, and so constructed that it cannot be tampered with in any way without an alarm being given at police station or residence.

W. I. B.

WESTERN NOTES.

Branch Office of The Electrical World,
Chicago, Nov. 27, 1886.

Mr. G. J. Melms, Superintendent of the new Omaha Thomson-Houston Electric Light Company, has placed an order with Munson & Co., of Chicago, for one main belt 32 inches wide and for nearly 300 feet of dynamo belting. The Munson belting seems to be growing more and more popular.

The Western Edison Light Company has been making some tests for efficiency at Oskaloosa, Iowa (see The Electrical World, Nov. 13), and Rockford, Ill. Their tests show that at the latter place 86 per cent. of the indicated horse-power was recovered as electricity. A first-class Corliss engine is used at Rockford. At Oskaloosa 80.5 per cent. was recovered, owing largely to the fact probably that the engine used (an old slide valve affair) was not at all adapted to the work required of it. It is not an infrequent thing for Mr. Leonard to obtain in his every-day plant an efficiency only two or three per cent. less than that given by the Edison exhibition at the Franklin Institute Show. This is an evidence of careful and painstaking work in the construction of plants. While speaking of the Edison Company, I will add that Mr. Leonard's records show fourteen lamps broken during October at Anamosa Penitentiary, Iowa. The breakage of nine of these lamps was due to normal causes, and five were broken through carelessness or other outside agency. Assuming, however, that all were broken by normal causes, and reckoning the whole fourteen in the calculation, the record shows that these fourteen lamps burned an aggregate of 29,851 hours, or an average of a little more than 2,100 hours each.

W. A. K.

THE TELEGRAPH.

Free Board.—The Boston *Globe* of Nov. 27 says: "Thomas C. Devine, a telegraph operator, was arrested yesterday by State Detective Batchelder, on the charge of forgery. It is alleged that Devine sent a telegram to A. Jones, a boarding-house keeper at Lawrence, Aug. 19, to which he forged the name of C. G. Sheehan, superintendent of the Baltimore & Ohio Telegraph Company in this city, and which stated that the company would be responsible for his (Devine's) board during his stay in Lawrence."

Damages Against Western Union.—At Memphis, Tenn., on Nov. 29, the United States Circuit Court decided a case against the Western Union Telegraph Company of interest to the public. A creditor at Memphis telegraphed to his lawyer as follows: "A. B. owes me $1,000. If grounds, attach." This dispatch was not delivered. Subsequently a similar dispatch was sent by another creditor to the same lawyer. An attachment was laid and the money made, but only enough to pay the second creditor. The first creditor sued the Western Union, and the court held the company liable for the debt. Judge Jackson, in delivering his opinion, said the dispatch disclosed on the face of it its importance.

THE TELEPHONE.

Long-Distance Lines Popular.—It is stated that more lines are required for the long-distance service between New York and Philadelphia. The rental is $300 per month.

The Telephone on German Railways.—From a report recently issued, it appears that the telephone has come into extensive use upon the German railways.

The Phœnix Construction Company, of Jersey City, N. J., has been organized with a capital stock of $200,000 by W. Friedman and others, to manufacture telephones, etc.

Telephone Wires in Russia.—Up to the present time there are about 10,670 kilometres of telephone wire erected in Russia, of which 4,000 are in St. Petersburg and 3,000 kilometres in Moscow.

Between Paris and Brussels.—A telephonic service between Paris and Brussels will be opened on Jan. 1, either by way of Lille or St. Quentin. The price of communications will be three francs for five minutes.

The Government Suit.—No further action will be taken by the government in regard to the suits against the Bell Telephone Company until the decree of the Circuit Court at Columbus shall be officially promulgated, which will be when the court reassembles Dec. 7.

New Use for the Telephone.—A novel experiment is about to be made by the United Telephone Company at Kensington. The company proposes to connect a number of first-class residences in that locality with the local exchange, and to allow the tradesmen the opportunity of communicating with their customers, or *vice versa*, for an annual payment of £1 per house and an additional £1 for every £100 worth of orders received by telephone.

What Mr. McDonald Thinks.—Ex-Senator Jos. E. McDonald, of Indiana, is one of the counsel for the defense of the Bell telephone patent in the suit brought by the government to break down the patent. In a conversation with a reporter he made the interesting declaration that, however the proceedings might be expedited, and whatever the courts might do, a final judgment by the Supreme Court on the matter could not be reached in less than seven years from the present, while the patent will expire in six years, and no judgment, whether for or against the patent, could be made retroactive.

Output of Instruments.—A good output of telephones is reported for the month ended Nov. 20, as follows:

Month to Nov. 20:	1886.	1885.		Changes.
Gross output	3,340	2,334	Inc.	1,006
Returned	1,825	3,750	Dec.	1,925
Net output	1,515	*1,416	Inc.	2,931
Since Dec. 20:				
Gross output	38,360	29,603	Inc.	8,757
Returned	18,230	27,045	Dec.	4,967
Net output	20,130	2,556	Inc.	17,570

* Net loss.

The Rochester Row.—A special dispatch of Nov. 27 from Rochester says: The telephone war has assumed a more determined aspect than ever. Yesterday a committee of Buffalo subscribers was in this city conferring with men prominent in the movement. Notwithstanding the statements to the contrary, the Buffalonians stated that there was much dissatisfaction with the Bell Company in their city, and that subscribers were ready to co-operate in a strike if there were prospects of success. It is probable that further conferences between the two cities will follow. Several Rochester capitalists have signified their intention of backing the new make and break phone, and a company will probably soon be organized. Meanwhile telephone service is entirely suspended.

The Marshall Telephone.—Mr. W. Marshall, the condenser maker, of University place, this city, claims to have constructed an operative make-and-break telephone, and is said to have filed an application for a patent thereon. "A novel feature in the Marshall system is the employment of a constant battery current upon the line in addition to the interrupted induced currents from the transmitter proper. It is difficult to understand exactly the precise action of this current, but experiments show that its efficacy is unquestionable. On a short line but one or two calls are required, and the ratio of increase as the line lengthens is about the same as that on the line of the common telegraph. By the use of this battery Mr. Marshall claims that telephony is as practicable on long lines as telegraphy, the electromotive force of the current being supplied by the battery and not by the instrument."

The Erie Telephone Hearing.—In his argument for plaintiff in the Erie telephone suit, Hon. Geo. F. Richardson contended that the points involved were: Did Bent perform the services for which he charges; if he did, did he perform them under such circumstances as to be entitled to receive pay for them; what are those services worth; has he lost the right to recover? Counsel claimed that evidence showed that Bent did perform the services charged for, and is entitled to be paid for them; that his charge is not excessive, and that he has not lost the right to recover. Mr. Richardson claimed that Glidden was the one who benefited by the forgery, alleged to have been committed by Bent, and that the latter was not likely to have perpetrated such a crime for another man's benefit. Glidden, he said, had confessed to falsifying the books, and he believed that a man who can falsify books and commit perjury is one who could really commit forgery if he wanted to. Bent had sworn that he gave the papers to Glidden unsigned, and in all the evidence taken there is not a blot on the character of Bent. He described Glidden as a greater and meaner traitor than Judas Iscariot or Benedict Arnold. At the close of Richardson's argument the case was adjourned to Nov. 30.

"Hello, Boston!"—The Philadelphia *Record* of Nov. 27 says: Long-distance telephoning between this city, New York, Boston and other cities of the country will be an accomplished fact in a very short time. Next week telephones will be in the

Continental Hotel, the Girard House, the Lafayette Hotel, and the Stock Exchange, through which speaking communication can be had with the Bell telephone systems of New York and Boston. The wires of the company which is operating this system, under the protection of the American Bell Telephone Company, will all be under ground, and enough of them have now been buried and connected so that the telephones can be put in all of the business centres of the city. The conduits are being rapidly extended along Walnut street and on Fourth street. The local Bell Telephone Company has not as yet made any arrangements with the Long-distance Telephone Company by which the two systems can be connected, as in New York. The line of wires has not yet been extended to Washington or Baltimore, but will in a short time extend to all the large Eastern cities. The wires are worked without the noise occasioned by induction, and a conversation can be held with the greatest ease with correspondents in New York and Boston.

THE ELECTRIC LIGHT.

Fulton, N. Y., is to be lit by a Thomson-Houston plant, under contract.

Southington, Conn., is to have an electric light plant, and Naugatuck another.

Nevada, Mo., will probably soon be lighted by electricity. Details can be had of Mr. John Martin.

The Seneca Falls Electric Light and Power Company, Seneca Falls, N. Y, has been incorporated.

Putnam, Conn.—The Putnam Electric Light Company has been incorporated by G. L. Miller and others, with a capital stock of $12,000.

The Racine Gas Company, Racine, Wis., is going into electric lighting, and has ordered a 60 horse-power Westinghouse engine.

Northampton, Mass.—The Northampton Electric Lighting Company has been incorporated by E. P. Copeland and others, with a capital stock of $40,000.

Westboro, Mass.—The Westboro Electric Light and Power Company, of Portland, Me., has been incorporated with a capital stock of $25,000. Mr. C. Whitney is the president.

Electric Head-Light.—The Pan-Handle Railroad has tested an electric head-light which is said to work satisfactorily. Incandescent lights on flexible wires are also attached to be used by the engine driver and fireman in oiling up.

The Pittsburgh Electric Light Company have commenced the erection of a 2,000-light Westinghouse plant on the South Side, the contract being awarded to Westinghouse, Church, Kerr & Co., of Pittsburgh and New York.

Pittsfield, Mass., is about to receive the benefits of incandescent lights. This is due to the enterprise of Mr. F. A. Robbins, who is putting in a plant on the Westinghouse system for the business portion of the city, and will extend as increase of custom requires.

Secondary Generators in Buffalo.—A dispatch from Buffalo says that the dry-goods store of Adam Meldrum & Anderson was successfully lighted by secondary generators or converters of the Westinghouse system. A company is to be formed there to work the system, and among the organizers are Wilson S. Bissell, President Cleveland's law partner, and John F. Moulton, president of the Brush Electric Light Company.

Adds to Health and Comfort.—Commodore J. G. Walker, Chief of the Bureau of Navigation, in his annual report to the Secretary of the Navy, says that electric light plants have been installed in the "Atlanta" and "Boston." He says: "This method of lighting ships-of-war, owing to the small amount of heat given off, the absence of disagreeable odors and the more perfect illumination, adds much to the health and comfort of the officers and men, tends to make them contented and happy during their long absence from home and friends, promotes discipline and prevents crime."

Wilkes-Barre, Pa.—The Edison central station at Wilkes-Barre has now gone into active operation. In the main building, on the ground floor, are two Ide engines, standing at the entrance to the room. One of these engines is of 80 horse-power, with a capacity for running two 400-light dynamos. The other engine has a capacity of 160 horse-power, running two 800-light dynamos. At a distant corner of the room stand two 800-light dynamos, awaiting the arrival of another 160 horse-power engine to run them. The two engines already connected with their dynamos will work constantly. The capacity of the incandescent machines, therefore, is 2,400 lamps, which is more than the public at present demands.

Providence, R. I.—Apparatus for an electric lighting plant is being put into the Narragansett Hotel, Providence, which is thus to have its own private plant. The Edison Electric Light Company, of New York, furnishes the plant. There are to be 450 lights, and 435 are already placed. The motor employed is an improved Greene engine from the Providence Machine Company. The driving-wheel has a diameter of ten feet, and a surface measurement of fifteen inches. The engine is a 50 horse-power, and is to make eighty-five revolutions per minute. The dynamo and engine are both located in the basement of the building.

Abington, Mass.—At a recent meeting of the Business Club in this place, the matter of electric lighting for the town was considered, and the unanimous sentiment seemed to prevail that some such plan would be a success. It is proposed to form a company for the purpose of introducing a system, at present to have both the arc and incandescent lights, so that both streets and houses may be illuminated. A committee was appointed to confer with the North Abington Improvement Society, to see if an arrangement might be perfected whereby the two towns could be supplied from the same plant. It is understood that the plan meets with considerable encouragement from the merchants and manufacturers in both places. The committee will report at the next meeting of the club.

Prices of Carbons.—The Cleveland *Plain Dealer* of Nov. 27 has the following: "A meeting of the carbon manufacturers of the United States is holding at the Forest City House. It began on Friday morning, and the delegates to the convention have not notified the public how long it will last. Prominent among the gentlemen present are G. W. Parker, president of the Parker-Russell Mining and Manufacturing Company, of St. Louis; Charles Heisler, manager of the American Carbon Company, of St. Louis; and D. D. Dickey, manager of the Pittsburgh Carbon Company, of Pittsburgh. A reporter was told that the convention had nothing for the public at present. The gentlemen have assembled to talk over important business matters, and it is understood that they will raise the present ruinously low price for electric carbons, so that in the future they can make a small profit out of their business."

New Thomson-Houston Plants.—The Cohoes Thomson-Houston plant recently erected by Mr. Henry W. Pope, of this city, is to be a model in completeness and workmanship. The steam plant consists of steel boiler with Jarvis setting and a Straight Line engine. The dynamo room is thoroughly equipped, neatly arranged and painted. The poles are extra large and straight, and were furnished under special contract with Mr. H. C. Ripley, of East Saginaw, Mich. All poles are well painted with two colors; the main body of pole is olive, while the top and butt, together with the cross arms, are black. The arrangement of circuits is such that water or steam power can be used jointly or separately, as circumstances may require. Mr. Pope has just completed a plant at Morristown, N. J., for the Morristown Electric Light and Power Company, equipped with Westinghouse engines, and is constructing another at Somerville, N. J. These last two plants are to be equipped with Thomson-Houston arc and Westinghouse incandescent.

Underground Wires Wanted in Cleveland.—The following memorial was received by the Board of Councilmen, referred to the Board of Improvements and Committee on Judiciary: "The Cleveland Board of Underwriters, composed of the agents of the various fire insurance companies doing business in this city, having heard of the proposition now under consideration by you, viz, the laying under ground of all electric, telephone and telegraphic wires, and realizing the great danger to life and property by the careless manner in which such wires are now placed, we present this memorial to you with the hope that you will see the necessity not only of placing all wires underground, but further, that all wires placed in buildings shall be securely protected by the best known devices. The reasons for our position are many, prominent among which are, the danger by fire by coming in contact with the electric wires, and the retarding of firemen in the discharge of their duties by the multiplicity of wires, making it almost impossible to raise their ladders for the saving of life and property. We trust that our appeal to you will not be in vain."

APPLICATIONS OF POWER.

Bray, Ireland.—It is proposed to construct an electric railway, about a mile long, at Bray, Co. Wicklow.

Littlehampton, Eng.—Operations are being vigorously pushed for the construction of the electric railway.

An Electrical Riveting Machine.—A riveting machine for ship work, the design of Mr. F. J. Rowan, has been given a trial in McMillan's Yard, Dumbarton, Scotland.

For Australia.—Lord Augustus Loftus, late Governor-General of New South Wales, visited the Brighton Electric Railway recently and inspected it closely. It is intended to introduce the system in Australia.

Power Distribution in Worcester, Mass.—A correspondent of the *Industrial World* says that the Worcester Electric Power Company is building up a good business in supplying power to small manufacturers, printers, tinsmiths, tailors, etc. This company has a large and complete central plant, and strings wires to lessees' premises. Power is furnished for $150 per horse-power per year, and the company is now able to put in 2, 4, 6, 10 and 15 horse-power motors. There is a strong and steady demand for two horse-power and smaller motors which will soon result in the placing of a good many of them. Visits to several users of the new power developed the fact that they were more than satisfied—were delighted—with it. The Worcester Company is not devoting all its strength to this business, and will soon have an electric railroad in operation. The Worcester & Shrewsbury Railroad Company has offered the Worcester Electric Power Company the use of its road and cars, and if the present active preparations are continued, Jan. 1 will see the practical operation of the Daft railway motor in Worcester.

Boston Street Cars.—The report of President Powers, of the Consolidated Street Railway Company, says: "The time has nearly arrived when the cable or electricity will be substituted to a considerable extent for the horses as a motive power. Should either or both be adopted, our road is peculiarly well adapted for it. Our real estate and buildings could be utilized for cable or electric purposes without any great expense. At the present time there exist some few defects in regard to the cable system, which will doubtless be remedied within a short time. Electricity has not as yet been quite fully or satisfactorily demonstrated as a success for the propelling of street cars. Electricians, however, claim that in a short time it will be made a success as a motive power for street railway purposes. Your directors, feeling that it was desirable for this company to make an early move in regard to the substitution of other motive power in place of horses, at their first meeting appointed a committee, of which Mr. Merrill is chairman, to take into consideration the expediency of substituting in part 'the cable' or 'electricity.' The committee has given considerable time and attention to the subject, having visited other cities for information, and they will doubtless be able to make a definite report upon the matter in the course of a few weeks." The Consolidated Company now owns over forty miles of railroad track.

PERSONALS.

Mr. Simon Cameron Wilson, Mayor of Harrisburg, Pa., died suddenly last week. Mr. Wilson was about 45 years of age. During the war he was chief electrician of the Northern Central Railway, and filled other positions of trust.

Capt. F. A. Cloudman, of Rondout, N. Y., left Savannah, Ga., on Nov. 28, in the 24-foot sloop yacht "Cutting" on a coast trip round the world. Captain Cloudman, it will be remembered, was the originator of the scheme for establishing ocean lighthouses, recently illustrated and described in our columns.

Mr. W. C. Goldner.—Friends of Mr. William C. Goldner will be glad to know that he is engaged with the celebrated electrician, Benoit Jainaut, in Paris, where, with an immense workshop and laboratory at his command, he can work out many problems originating from his experiments in behalf of the Chemical Electric Light and Power Company. M. Jainaut, by the way, is the man who in 1882 patented soda for battery solutions, and, it is said, anticipated the Kauffer patents. The Chemical Company, however, bought his rights and secured a United States patent here.

Mr. M. Lee Ross.—Upon the retirement of Mr. Lee Ross as general manager of the Royal Electric Company, of Montreal, the employés desired to show their appreciation, and presented Mr. Ross with a very handsome gold-headed cane, accompanied by a beautifully illuminated address, signed by 100 employés. The presentation was made by Mr. Charles W. Hagar, secretary-treasurer of the company. At a directors' meeting, held at the company's offices, a letter was read from Mr. Ross resigning the position of manager of the company, to take effect from Nov. 15, owing to his having embarked in another enterprise. It was accepted. The board placed on record their appreciation of the efficient manner in which he had filled the position, and also the fact that by his efforts the company had obtained its present high standing. It may be mentioned that through Mr. Ross some twenty-five local electric lighting companies have been formed in the Dominion.

STOCK QUOTATIONS.

The following list, compiled by Mr. W. H. Baker, member New York Stock Exchange, 16 and 18 Broad street, gives the current quotations of electrical stocks:

November 29, 1886.

TELEGRAPH.	Bid.	Asked.
Am. Dist.	.....	40
Am. Tel. & Cable	77	77½
Cen. & So. Am.	75	100
*Com. Tel.	.....	.....
*Gold & Stock	93	97½
*Inter. Ocean Tel.	92	.....
N. Y. Mutual	.....	.....
Pac. & Atl.	45	55
*Postal T. & C.	20	.....
South. & Atl.	65	75
W. U. Tel.	79⅝	79¾
W. U. Scrip.	71	.....
W. U. Bonds	.....	122
Mut. U. Bonds	85⅝	85½
TELEPHONE.		
Am. Bell	204½	205
Am. Speaking	105	.....
Erie	28	28¼
*Hudson River	.....	55

TELEPHONE.	Bid.	Asked.
Mexican	.....	1½
*N. Y. & N. J.	.....	89
N. Y. & Pa.	.....	.....
New England	43½	44
*Southern Bell	100	130
ELECTRIC LIGHT.		
*Am. Electric	.....	.....
*Brush	.....	.....
*Brush Ill	.....	.....
*Consolidated	.....	.....
*Daft	.....	.....
*Edison	125	.....
*Edison Ill	85	.....
*Edison Isolated	100	.....
*United States	.....	.....
*U. S. Ill	91	100
MOTOR.		
*Daft	.....	.....
*Sprague	600	.....

* These stocks are so seldom dealt in that it is difficult to give prices at which they can be bought or sold. The figures given are as near as can be ascertained.

MISCELLANEOUS NOTES.

Richardson Conduit in Boston.—Work will shortly be begun in Boston on a conduit for the New England Telephone Company. The Richardson carbonized stone cement pipe will be used; 2,600 feet of 9-duct pipe will be laid along Tremont street.

The International Electric Company has been incorporated at Louisville, Ky., with a capital stock of $500,000, by S. F. Miller, C. P. Moorman, H. W. Barrett, J. White, H. Scott and others. The company proposes to do a general electrical manufacturing and trading business.

Paris International Exhibition, 1889.—The first meeting of the recently appointed committee on electro-technics in connection with this exhibition was held on Nov. 8. M. Mascart was elected president, and four vice-presidents for the sub-sections were appointed as follows: Lighting, M. Bartel; experimental work, M. Becquerel; dynamos and motors, M. Maurice Levy; telegraph, telephones, etc., M. Blavier.

The National Superheated Water Company has been incorporated in this State with a capital of $500,000, for the purpose of manufacturing apparatus for use in inventions relating to the use of superheated water for motive power, heating, cooking, or any other useful application. Its corporators are Edward Russell, Joel Noble Hayes, Jr., and Harry S. Goodridge, and its trustees are Nathan Guilford, Richard A. Elmer, Edward J. Hall, Jr., Burton N. Harrison, William E. Prall, Samuel M. Bryan, and Theodore N. Vail.

Electric Gas-Engine Speeder.—Charles E. Skinner, of Yonkers, N. Y., is the inventor of a gas-engine speeder. It is a combination with a gas-engine and a dynamo-electric machine, of a variable or speed-changing mechanism, comprising a two-armed lever and frictional wheels supported upon trunnions or studs, and having pulleys on their hubs for transmitting motion from the engine drive-wheel or pulley of the dynamo machine, either of the wheels being movable into contact or engagement with the drive-wheel. Explosions in the gas-engine are produced by the spark of an electric current generated by a dynamo electric machine. The method of operating is by temporarily increasing the relative speed of the dynamo while starting the engine, and decreasing it when the engine has attained its regular or required speed by means of two wheels secured on arms of a lever.

Cremation by Electricity.—A movement has been set on foot in Italy toward erecting in one of the principal towns an electrical crematorium. In this edifice the corpses will be instantly consumed by means of an intense heat caused by electricity. Various European cremation societies are reported to have dispatched representatives to Italy to make inquiries as to the feasibility of the scheme, which, it is expected, will, if successful, very soon replace the more elaborate methods now generally adopted. Partisans of cremation are sanguine that the introduction of electricity would instantly remove the objections held by many European States against the burning of bodies. Dogs—we presume dead dogs—have already been subjected to the process by its inventor with a considerable degree of success. Their bodies forthwith evaporated into nothingness, and there was perceptible none of that disagreeable odor of burning flesh which

inhabitants of Woking are said so greatly to resent.—*Pall Mall Gazette.*

The Accumulator in America.—A well-informed English correspondent sends us the following, which, though not new in the main to our readers, is interesting as a bit of the gossip current on the other side: "Since Mr. Vail left the American Bell Telephone Company, a year ago, his movements have been wrapped up in some mystery. The secret is now out. Mr. Vail has gone into the accumulator business with the determination to make of it a still greater concern than ever the telephone has been. He and his friends have acquired the exclusive rights in the States of the patents for accumulators of Faure, Volckmar, Sellon, Swan and many others. He has himself visited Europe two or three times during the year, and on one occasion took back with him a party of twenty electricians who had been specially trained in the manufacture of the Faure and Sellon accumulators at Millwall, London. It is stated that Mr. C. A. Faure has been engaged as chief of the experimental and laboratory department, and that Mr. W. W. Griscom will be engineer of the new factory started by Mr. Vail at Newark. A big boom in accumulators seems imminent."

BUSINESS NOTICES.

Anti-Magnetic Shields.—Messrs. Giles Bros. & Co., Chicago, Ill.: Gentlemen: Your Anti-Magnetic Shield for Watches cannot be overestimated. It is now very near eight months that I have worn my watch, and to-day it is, without ever correcting time, about one minute slow. Considering the fact that I am every day near Dynamo-Electric Machines in our regular business, the test could not be harder. I could never have believed that the protection was so complete.

In this age of electricity, not only electricians, but every one who needs correct time, should have the Anti-Magnetic Shield. A good deal of practical utility, as well as pleasure, can be derived from a good time-keeper. At present I look upon a watch without a shield as a thing incomplete; and so it is.

Very respectfully, CHAS. J. VAN DEPOELE,
Electrician V. D. P. E. M. Co.

Address GILES BRO. & CO., for particulars, price, etc.

Jordan & Gottfried, 208 Canal St., N. Y., carry a complete stock of iron and brass machine and wood screws, bolts, cap and set screws, taps, dies, files, twist drills, brass and rubber in tubing, rod and sheet copper, brass, German silver steel and iron wire, shafting tools, etc.

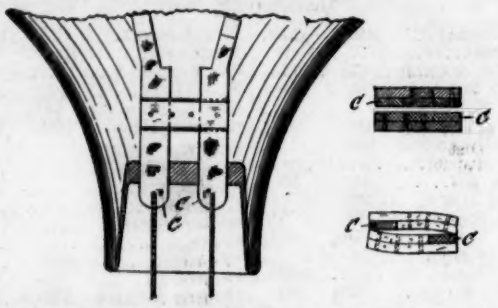
In the advertisement of the Commissioners of Hospitals for the insane of Indiana, which appeared in this paper November 20th and 27th, the date, January 4th, 1887, was omitted. Applications for lighting will be received daily at the Governor's office at Indianapolis until that time. See advertisement on opposite page.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED NOV. 16, 1886.

352,549. Watchman's Electric Signal Box; William W. Le Grande and George W. Burton, Louisville, Ky., said Le Grande Assignor to said Burton. Application filed Feb. 9, 1886. Includes various details whereby the action of watchman's signaling apparatus is rendered more certain.

352,571. Railway Signal; Charles Wm. Pridham, Earl's Court Road, County of Middlesex, England. Application filed Oct. 21, 1885. Describes apparatus for signaling from a station to an engineer on a railway train. The train carries devices which make contact with conducting posts in circuit with telegraphic instruments at the railway station.



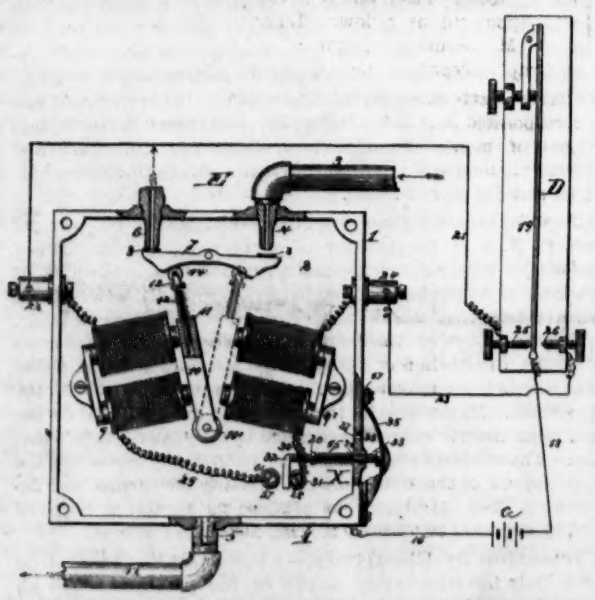
352,622. THERMOSTATIC CUT-OUT FOR INCANDESCENT LAMPS.

352,577. Line Connection for Mechanical Telephones; George F. Shaver, New York, N. Y. Application filed Jan. 25, 1886. Provides means whereby one or more branch wires in a mechanical telephone system may be connected with the main wire, and all the wires may be kept at substantially the same tension.

352,596. Hinge Connection for Electrical Instruments; George W. Wilson, Boston, Mass., Assignor to the American Bell Telephone Co., same place. Application filed June 26, 1884. A spiral wire or spring is made to preserve electrical connection between two parts of a hinge, whether the latter is open or closed; or the ordinary hinge may be replaced by a hinge made of a spiral wire or spring.

352,600. Telegraph Instrument; Chauncey G. Wright, Chicago, Ill. Application filed Jan. 6, 1886. The main object of the invention is to produce a single instrument adapted to receive and register a telegraphic message by perforating a ribbon with what are known as the Morse characters.

(1) 352,621. Cut-out for Incandescent Lamps; (2) 352,622. Thermostatic Cut-out for Incandescent Lamps; Herman Lemp and Merle J. Wightman, Hartford, Conn., Assignors to the Schuyler Electric Light Co. Applications filed Aug 19, 1886, and Aug. 27, 1886, respectively. (1) Improvement on an invention described in an application filed March 2, 1886. (2) The apparatus includes thermostatic "expansion-pieces" located within the lamp and in proximity to the filament, and adapted to establish electrical connection between the leading-in wires upon an increase of temperature due to the rupture of the filament. The illustration shows the device



352,874. SYSTEM OF TEMPERATURE REGULATION.

attached to an incandescent lamp; *c c* are the leading-in conductors, and the upper detail to the right shows the device under normal conditions; the one below, when the filament is ruptured and the thermostat has expanded, due to the heating by the current.

352,625. Electric Lamp; Darius Lyman and Marshall Wheeler, Washington, D. C. Application filed Feb. 8, 1886. [For description, see page 275, this issue.]

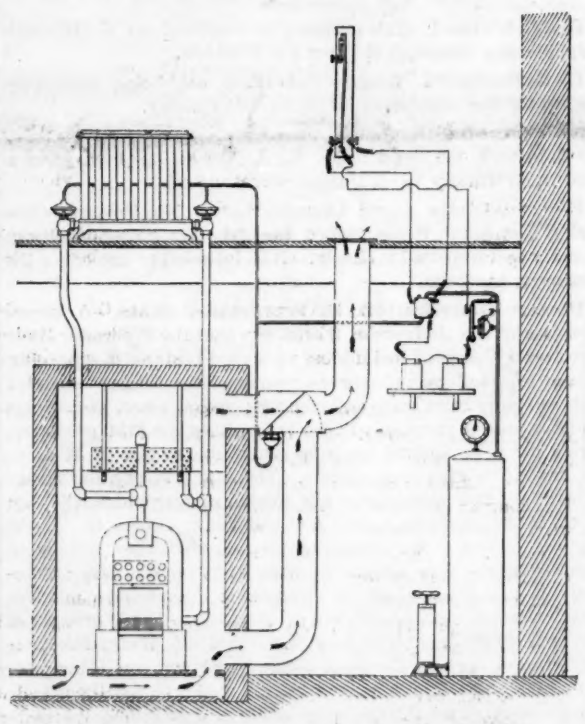
352,615. Rapid Fire Signal; Thomas F. Gaynor, Lexington, Ky. Application filed April 3, 1886. The objects are to dispense with the necessity for procuring a key to a fire alarm signal box; to provide means whereby the officials may know that a signal is about to be sent; to detain the signal sender at the box if his signal is received; to enable him to go to the next signal box if his first signal is not received; and to accomplish various other results.

352,691. System of Electrical Distribution; John W. Howell, New Brunswick, N. J. Application filed April 15, 1886. The electrical pressure at different points in a system of distribution is determined by comparing it with the pressure at a given point where an absolute pressure indicator is located. The object is to dispense with all absolute indicators except one, and thus decrease the number of complicated instruments to be kept in order and obviate to that extent the chances of derangement. The comparative or "resultant" indicators used by the inventor, are simpler than the ordinary absolute indicator.

352,700. Electrical Railway Signal; Sidney C. Mahanay and Ben L. Campbell, Near Manchester, Mo. Application filed April 14, 1886. An audible signal is located at a railroad crossing and operated by approaching trains.

352,708. Storage Battery; Otto A. Moses, New York, N. Y. Application filed January 18, 1886. The objects of the invention are to simplify the manufacture of the plates, insure that the porous or cellular portion shall be in perfect electrical connection with the base or frame of the plates, and to dispense with the employment of binding screws and coupling devices for connecting different plates. Referring to the illustrations, the arms of the U-shaped plates shown constitute, one, a positive battery electrode, and the other, a negative electrode.

352,725. Telegraphic Relay; George Westinghouse, Jr., Pittsburgh, Pa. Application filed Aug. 30, 1886. A rod or stem is operated by the movements of the armature and is pressed upon by springs. When the armature is attracted, the



352,874. SYSTEM OF TEMPERATURE REGULATION.

rod acts upon the springs to press them into contact. The springs operate both as a stop to limit the movement of the armature, and as the make and break of a local circuit.

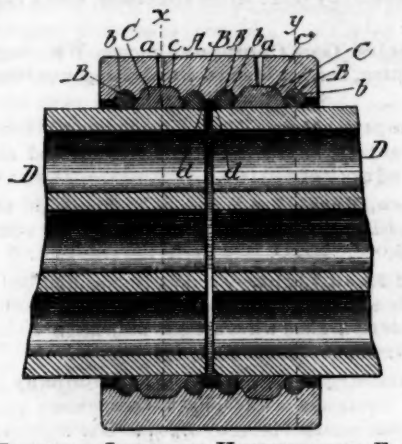
(1) 352,735. Telephone; (2) 352,806. Microphone Transmitter; William R. Cole, Detroit, Michigan, Assignor to himself, Frank G. Smith and George W. Moore, trustees, same place. Applications filed May 27, 1886. (1) The telephone consists of a diaphragm and a permanent magnet at right angles to the diaphragm, the permanent magnet having one of its poles free and its opposite pole adjustably secured to one of the poles of an electro-magnet. The object is to secure a sensitive receiver. (2) The electrode affected by the movements of the diaphragm is attached to one end of a curved spring bar, the centre of which bar is in contact with the diaphragm.

352,754. Flexible Joint for Underground Electrical Conduits; Seth E. Hurlbut, Chicago, Ill. Application filed June 14, 1886. The claim describes the construction: The combination with two conduit-sections capable of movement relative to each other, of a ring or collar having interior circumferential grooves, *b*, the flexible packing *B*, held in said grooves by its own elasticity and projecting beyond said grooves, the grooves *c*, arranged between said packing *B*, and the permanently-plastic filling *C*, contained in said grooves *c*, the ring or collar having holes *a* communicating with the grooves *c*. Improvement on the invention disclosed in patent No. 340,046. [See illustration.]

352,771. Underground Tube for Electric Wires; Herbert G. Morehouse, Croton Landing, N. Y. Application filed August 16, 1886. A series of small iron or steel tubes is provided, each lined throughout with an enamel insulating coating fused thereon and continuously connected. The naked wires are laid within the tubes.

352,796. Electric Igniter for Gas Engines; Cyrus W. Baldwin, Yonkers, N. Y., Assignor to William E. Hale, Chicago, Ill. Application filed July 11, 1884. A hollow shell extends through the cylinder, and two insulated wires pass through the shell, their ends being brought into close proximity. Sparks are caused between the ends of the wire at proper intervals by means not illustrated nor claimed in the patent.

352,861. Burglar Alarm; Charles H. Dowden, Newark, N. J. Application filed March 11, 1886. A device intended to be attached to windows to operate an electric circuit when the windows are opened. Two metallic buttons are placed in the jamb of the window-frame and pressed against the outer



352,754. FLEXIBLE JOINT FOR UNDERGROUND ELECTRICAL CONDUITS.

end of the window-sash by springs. When the lower sash is raised or the upper sash lowered, contact is established between the buttons and a metallic strip, thereby closing an electric alarm circuit.

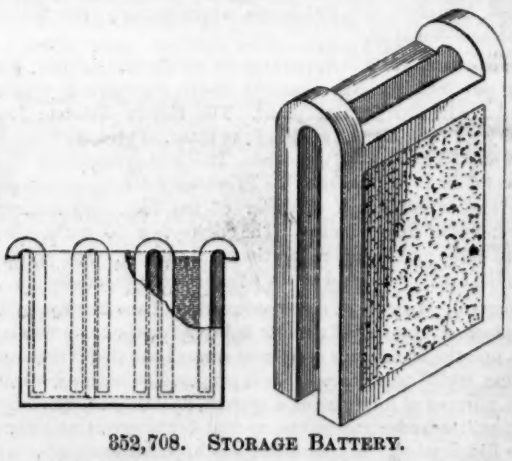
352,865. Duplex and Quadruplex Telegraphy; Samuel P. Freir, Roselle, N. J., Assignor to the Western Union Telegraph Company, New York. Application filed Aug. 13, 1886. The object is to replace by automatic transmitters two of the manual transmitters ordinarily employed in quadruplex telegraphy—one at the home station and one at the distant station.

352,874. System of Temperature Regulation; Warren S. Johnson, Milwaukee, Wis., Assignor to the Johnson Electric Service Company, same place. Application filed April 20, 1886. A fluid under pressure is used to control valves for regulating the heat of a room. The fluid is itself controlled by electro-magnetic action, and the electric circuits are operated by thermostats located in the room whose temperature it is desired to regulate. [See illustration.]

352,877. Galvanic Battery; Edwin J. Leland, Worcester, Mass. Application filed Aug. 24, 1885. The battery jar is sealed hermetically at the top and contains an exciting fluid, midway in which a ring-shaped positive electrode is suspended. A closed hopper-shaped reservoir containing crystals of an exciting salt is suspended from the cover of the jar, and its lower end is placed within the ring forming the positive electrode. The bottom of the reservoir is made of wire gauze, so as to allow the salt to be acted upon by the exciting fluid. The negative electrode is placed in the bottom of the jar and surrounded by suitable depolarizing material.

352,900. Telephone Transmitter; Malone Wheless and James D. Darden, Washington, D. C., said Wheless Assignor to said Darden. Application filed March 6, 1886. One of the contact electrodes is kept moist and smooth, whereby the common "grinding" sound is avoided.

352,903. Electro-Mechanical Signal Apparatus;



352,708. STORAGE BATTERY.

William W. Le Grande, Louisville Ky., Assignor of one-half to H. R. Dering, W. W. Dering, and T. H. Upperman, all of same place, and George E. Rockwell, Indianopolis, Ind. Application filed Oct. 14, 1885. Provides means whereby the train having the right of way receives the first "clear" signal. The invention embraces many details of construction.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patent issued since 1866—can be had from this office for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, New York.